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PENETRATING RADIATION ASSOCIATED WITH THE X-RAYS.

As the following investigation is made with the aid of nuclei, certain of their properties bearing on the present subject will first have to be specified. Exhaustions are preferably made at a pressure difference (δp) just below the point (to be called *fog limit*) at which dust-free non-energized saturated air condenses without foreign nuclei. δp depends on the particular apparatus used.

1. *Fleeting Nuclei.*—Let the X-radiation to which the dust-free air is exposed be relatively weak, so that the density of ionization may remain below a certain critical value. The nuclei observed on condensation are then very small and they require a high order of exhaustion, approaching the fog-limit of non-energized air. They are usually instantaneously generated (within a second) by the radiation, so that their number is definite independent of the time of exposure. They decay in a few seconds after the radiation ceases; *i. e.*, roughly to one half their number in two seconds, to one fifth in twenty seconds in the usual exponential way. I fancy that these nuclei are what most physicists would call ions; but nevertheless the particles are not of a

size, their dimensions depending on the intensity of the penetrating radiation to which they are usually due; and they pass continuously into the persistent nuclei as shown in the next paragraph, where decay of ionization and of nucleation are very different things. Finally (§ 3) they are stable on solution. The case seems rather to be one in which the rate of decay exceeds the rate of production. The following is an example of data bearing on this case, N being the number of nuclei caught per cubic centimeter. The anticathode is at a distance from the fog-chamber and the exhaustion carried to the verge of the fog-limit of dust-free air.

Time of exposure: (rays on)	0	5	15	30	60	120 secs.
$N \times 10^{-3}$	*1.6	74	74	—	74	—
Time after exposure: (rays off)	0	5	15	30	60	120 "
$N \times 10^{-3}$	92	30	23	18	10	4

The two series refer respectively to generation and to decay.†

2. *Persistent Nuclei.*—If the X-ray bulb is approached nearer the fog-chamber or if a more efficient bulb is used so that the density of the ionization within the fog-chamber is sufficiently increased, the rate of production of nuclei will eventually exceed the rate of decay. The nuclei are now persistent for hours after the radiation ceases. The number N per cubic centimeter increases in marked degree and at an accelerated rate with the time of exposure to the radiation, certainly for ten minutes or more, barring the invariable loss of efficiency of the X-ray bulb. These nuclei are large, requiring very little supersaturation for condensation and are much like any ordinary nuclei. They are pronouncedly of all sizes and the initial coronas are apt to be distorted and stratified beyond recognition. Whirling rains and fog accompany the first condensation. While small nuclei occur throughout the chamber, the end near the bulb is at first the seat of growth which gradually extends to the other end, as I have shown elsewhere.* The following two series of data showing the generation and decay of nuclei in question may be cited as illustrations. The pressure difference $\delta p = 20$ cm., much below the fog-limit for dust-free air, in the given apparatus.

Time of exposure	0	5	10	20	60	120	180 secs.
$N \times 10^{-3}$	0	2	11	10	20	†(100)	†(500)
Time after exposure	0	35	85	240 minutes.			
$N \times 10^{-3}$	†(100)	36	20	vanishing.			

Hence there is a decay of one half in ten minutes, and to one fifth in eighty minutes, or the degree of persistence is 200–300 times larger than in the first paragraph. The data indicate, moreover, that both of these extreme types of nuclei and all intermediate types now occur together, as may be tested by changing the pressure difference, δp, on exhaustion. Intermediate rates of generation and decay may be obtained by moving the bulb nearer to or farther from the end of the fog chamber. Finally the rates at which the nuclei and the ionization severally decay, between which it would be difficult to distinguish in the case of the very fleeting nuclei, stand in sharp contrast with the persistence of the nuclei of the present paragraph.

3. *Fleeting Nuclei Become Persistent on Solution. Origin of Rain.*—Let the fog-chamber be exposed to radiation for a few seconds and thereafter exhausted ($\delta p = 25$) as usual. Closing the exhaustion cock and allowing only time enough to measure the first corona, let the influx cock be opened and the fog-chamber be refilled with dust-free air. The (primary) corona observed is thus dispelled before much subsidence of fog-particles can take place, though the rain will naturally drop out. If the fog-chamber is now left without interference

* Fog limit of dust-free air just exceeded.

† Including loss by diffusion or other time-loss.

* *American Journ. Sci*, XIX., 175.

† Computed from the second exhaustion, after subsidence of the dense fogs of the first.

(the radiation having been cut off immediately after the first exhaustion) for one or more minutes or longer, a second exhaustion to the stated limits will show a large (secondary) corona relatively to the primary corona. In other words, relatively many of the fleeting nuclei or ions caught in the first fog have persisted, whereas without condensation, they would have vanished at once after the radiation was cut off. The following is an example of data bearing on this point, t denoting the time elapsed from the evaporation of the first corona to the precipitation of the second, N_1 the number of nuclei in the first and N_2 the number in the second corona.

$t =$	60	120	300 seconds.
$N_1 \times 10^{-3} =$	53	27	53
$N_2 \times 10^{-3} =$	16	7	15

The experiments are complicated by the variable X-ray bulb; but it is obvious that while all the nuclei would have vanished in a few seconds without condensation, about one fourth (in other experiments more) persist indefinitely if reevaporated after condensation from fog-particles.

This result has an important bearing on the whole phenomenon of condensation and nuclei. Clearly the latter, after the evaporation specified, become solutional or water nuclei, in which the original fleeting nucleus or ion behaves as a solute. The decreased vapor pressure due to solution eventually compensates the increased vapor pressure due to curvature, after which at a definite radius, evaporation ceases and a water nucleus results. Such a nucleus, however small, must be large in comparison with the dissolved ion. Hence on condensation the water nuclei will capture the moisture soonest and grow largest. Now in any exhaustion about one eighth of the fog particles, *i. e.*, those which are smallest and whose nuclei have been caught at the end of the exhaustion, regularly evaporate into the larger particles to a residue of water nuclei. These are then the first to be caught in a succeeding exhaustion. This is the explanation of the *rain* which not only accompanies all coronas in dust-free air, but is often dense. It is also an explanation of those indefinite alternations of large and small coronas (periodicity) which I described in detail elsewhere.

4. *Secondary Generation.*—This is a curious phenomenon, showing that the decaying nucleus is apparently radioactive, or that the walls of the fog-chamber are so, or else that the large nuclei if left without interference break into a number (on the average about three) of smaller nuclei, whereby the nucleation is actually increased in the lapse of time after exposure. In other words, if the nucleation is observed without cutting off the radiation in one case, and if in the second case the nucleation identically produced is observed at a stated time after the radiation has ceased, the number in the latter case (anomalously enough) is in excess. The following examples make this clear, the X-ray bulb being 5 cm. from the fog-chamber, and the exhaustion carried to $\delta p = 20$ cm.

Rays on.....	2	2	2	2	2	2	2	2	2	minutes
Rays off.....	0	4	0	4	0	2	0	20	0	"
$N \times 10^{-3}$	20	52	20	32	25	30	13	34	30	

These data are computed from the second exhaustion, as the first show the densely stratified fogs unavailable for measurement. With the bulb at different distances from the fog-chamber, the following data admit of the same interpretation.

Distance, $D =$	5	10	15	5	10	15 cm.
Rays on.....	2	2	2	2	2	2 minutes.
Rays off	0	0	0	0	0	0 "
$N \times 10^{-3}$	22	3	1	58	9	1

The phenomenon vanishes when the radiation is too weak to produce persistent nuclei, therefore either when the bulb loses efficiency or when it is too far from the fog-chamber. These results recall the corresponding behavior evoked by radium in

sealed tubes, specified in my last article.* See § 6.

5. *Space Surrounding the X-ray Tube a Plenum of Radiations.*—While the phosphorescence, photographic and electric effects of X-radiation decreases rapidly with the distance D from the tube, the nucleating effect (N nuclei generated per cubic centimeter, instantly) is nearly constant over relatively enormous distances.† Thus to give an example among many ($\delta p = 25$ cm.):

D = ...	6	200	600	6	200	600	cm.
$N \times 10^{-3}$	88	83	83	79	79	79	

The law of inverse squares would predicate a reduction of 10,000 to 1 between these limits; and in fact at 6 cm. the phosphorescent screen is intensely luminous, at 200 cm. very dim, at 600 cm. quite dark, as in the case of any ordinary illumination. The leaves of an electroscope within a glass bell-jar collapse in a time which is directly as the square of the distance from the energized X-ray bulb. The result obtained with nuclei is astonishing; the nuclei-producing radiation would at first sight seem to be of an extremely penetrating kind, akin to the gamma rays of radium and distinct from the ordinary phosphorescence-producing X-rays. This impression is accentuated by the fact that the radiation can not be stopped by lead screens many centimeters in thickness, placed between bulb and fog chamber. The following are typical examples, in which the distance between the lead plates screening the fog chamber and the X-ray tube is $D = 600$ and 200 cm., respectively. N shows the number of nuclei instantly generated behind the plates in the two cases.

Thickness of lead screen	0	.14	.28	.56	.84	1.12	0 cm.
$N \times 10^{-3}$	67	28	28	31	29	31	76
$N \times 10^{-3}$	79	44	48	41	—	44	70

Again the X-ray tube apparently emits this radiation forward as well as rearward, as if the thin anticathode were quite pervious. I found, for instance, for the radiation of the anticathode at 6 meters from the fog chamber,

from the front face (tube directed), $N \times 10^{-3} = 42$
from the rear face (tube reversed), $N \times 10^{-3} = 35$,

or 81 per cent. of the former apparently issues from the rear face. Even the reversal of the current does not stop the radiation, for about 16 per cent. of the normal intensity is still radiated when the concave mirror is made the anode.

The total efficient radiation may be reduced to a limit by lead screens a few millimeters in thickness or less; thereafter it can not be further reduced by lead screens many centimeters in thickness. For instance, when the radiation comes from 600 cm., a single lead plate (thickness .14 cm.) is more than sufficient to reduce the effective radiation to a minimum, which amounts to (somewhat less than) one half of the total intensity, at least when estimated in terms of the number of nuclei produced. If the nucleation comes from 200 cm., one plate has the same effect, even though a thickness of 400 cm. of air has been removed. The thickness, .14 cm., is more than enough to reduce the radiation to the limit in question. This again amounts to a little more than one half the total intensity. At a distance of 5 centimeters no more plates may be needed; but the conditions are now too complicated to be described here, chiefly because persistent nuclei are producible. Moreover 80 per cent. of the total intensity may ultimately escape absorption. Thus the rays from different distances behave alike for the more pervious media (§ 5), and in relation to very dense screens.

* Science, XXI., 275.

† Supposing that the fog-chamber is not enclosed in impervious metal. In the latter case, with the lead covering open towards the X-ray bulb only, there is constancy of N within 20 per cent. over 6 meters.

6. *Lead-Cased Fog-Chamber.*—To interpret these surprising results it will be necessary to surround the fog-chamber with a casket of lead, having a lid on the side fronting the X-ray bulb; for even though the lead plates above may efficiently cut off the primary rays, they would leave the secondary radiation free to enter laterally through the broadsides of the fog-chamber. When this was done the results reduced the penetrability of lead to a more reasonable figure as may be seen from the following example of results when the distance between bulb and fog-chamber was 2 meters.

Thickness of lead penetrated	= 0	.14	.28	.42	cm.
$N \times 10^{-3}$	= 77	10	7	5	

i. e., 14, 9 and 7 per cent. of the total intensity passes one, two and three plates respectively. A glass plate 7 mm. thick and an iron plate .5 mm thick allowed about 90 per cent. to pass, when the casket was left open and the lead plate placed near the bulb 17 per cent. of the total radiation was effective, the excess being of secondary origin. The passage through a plate of tinned iron may be observed for a bulb 6 meters distant as follows:

Thickness of plate	0	.05	.10	.20	cm.
$N \times 10^{-3}$	36	28	11	7	

It follows then that in the above examples (§ 5) nearly one half of the total radiation was derived from secondary sources since the primary radiation was certainly stopped off to within 10 per cent. by the lead plates. To the eye of the fog-chamber, therefore, the walls of the room are aglow with radiation, and no matter in what position the bulb may be placed (observationally from 6 cm. to 6 m. between bulb and chamber), the X-illumination as derived from primary and secondary sources is constant everywhere. It is to be understood that the 'X-illumination' here referred to may be corpuscular. In fact, so far as I see, the primary and secondary radiation here in question may be identical; for the corpuscles may come from the circumambient air molecules shattered by the shock of gamma rays. The latter would in turn be traceable to the atomic disintegration of the anticathodal platinum while under bombardment by the cathode torrent.

The fog-chamber, if open at the end toward the bulb, shows the same total intensity; but in such a case the inner walls of the casket, etc., become the source of secondary rays. The closed lead casket, however, sometimes introduces a discrepancy, for the coronas on second exhaustion are fainter, but nearly as large as on the first. Hence the lead itself is radioactive or it becomes so after becoming energized by the X-rays. This recalls § 3 on the behavior of radium in the sealed tubes as specified in my last paper.

7. *Ordinary Dust-free Air an Aggregate of Nuclei.*—The steam jet shows that nuclei of small relative size, but, nevertheless, large as compared with the molecules of air must normally be present in dust-free air: for the axial colors may be kept permanent at any stage by fixing the supersaturation. Such nuclei may be called colloidal molecules. Moreover, the available nuclei to be reckoned in millions per cubic centimeter increase with enormous rapidity with the supersaturation, in proportion as the molecular dimensions are approached. But even when the yellows of the first order vanish, condensation probably still takes place on the colloidal molecules specified. It is natural to associate these extremely fine nuclei with the existence of a very penetrating radiation, known to be present everywhere. Moreover, the occurrence of many nuclei with but few ions is not contradictory, if the latter are only manifest when the former are made or broken.

8. *Conclusion.*—It has been shown that for very short exposures (§ 3), the nuclea-

tion is the same, whether the bulb is placed at 6 cm. or 6 m. from the fog-chamber. But only in the former case ($D = 6$ cm.) is the effect cumulative; only for very short distances will persistent or large nuclei appear if the exposure is prolonged several minutes. I have, therefore, suspected that the radiation from the X-ray bulb is twofold in character, that the instantaneous effect (fleeting nuclei) is due to a gamma-like ray quick-moving enough to penetrate several millimeters of iron plate appreciably even for $D = 6$ meters; furthermore, that the cumulative effect (persistent nuclei) is due to X-light properly so called, which produces the usual effects subject to the law of inverse squares.

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The Biological Laboratory of the Bureau of Fisheries at Woods Hole, Mass. Report of Work for the Summer of 1904.[*]

The laboratory was opened to investigators on the fifteenth of June, and continued in operation until near the close of September. During the whole or a part of this period twenty-eight investigators were engaged in work upon problems of marine biology. A brief statement of the special subjects of research will be given below.

I. Equipment, Staff, etc.

The same portions of the station were occupied as during the preceding season, and need not again be detailed; the steam vessels *Fish Hawk*, *Phalarope* and *Blue Wing* were in service during the whole or a part of the season; the zoological library of Brown University was again generously placed at the disposal of the laboratory. Two fish pounds were set, one being placed, as formerly, in Buzzards Bay, not far from the station, the other being planted at No Mans Land, a small island a few miles to the south of Marthas Vineyard. Here a camp was located, several assistants being detailed to tend the trap for a period of about seven weeks.

The staff of the laboratory, for the past season, consisted of a director and seventeen assistants, together with a matron, two janitors and a chambermaid. To this list should be added a clerk and a collector, permanently attached to the station, and the crews of the various vessels. Of the assistants, three had immediate supervision of certain branches of the survey work; three others had charge respectively of the library, the supply room and the fish traps; while the remaining eleven rendered various services in the laboratory or in the field. Mention should also be made here of seven salaried investigators, employed by the bureau to conduct independent researches.

The plan of having a 'seminar' or research club, for the discussion of work in progress at the laboratory, was successfully continued, some of the meetings being largely attended by outsiders, as well as by investigators at the station.

II. Biological Survey.

The biological survey of the neighboring waters, commenced during the preceding season, was actively continued. The *Fish Hawk* was at the disposal of the laboratory for some five weeks, during which period she was chiefly engaged in dredging work in Buzzards Bay. In all 66 'stations' were dredged by this vessel, these being located at regular intervals over the bottom of the entire bay. The supervision of this branch of the work was intrusted to Mr. Leon J. Cole. Dredging in Vineyard Sound was likewise continued. A number of the stations (18) of the preceding year were again located and dredged, but the principal work

[*] Report to the Commissioner of Fisheries by the director of the laboratory.

in the sound was done in the shallower waters near shore. Here the *Phalarope* was employed on account of her lighter draught. This vessel was specially equipped for the purpose at the commencement of the season; a large movable platform being built and a derrick erected. Mr. R. C. Osburn supervised, for the most part, the dredging operations of the *Phalarope*. Seventy-seven 'stations' were dredged, completing the coast line of Vineyard Sound, upon both sides. Dr. Bradley M. Davis, assisted by Miss Lillian MacRae, directed the collecting and identifying of the botanical material secured.

Systematic records were of course kept of all species found in the dredge. As far as possible, identifications were made in the field or in the laboratory, but much material was preserved for reference to specialists. During the preceding winter, many of the species taken during the summer of 1903 had been determined by various experts, and this collection has now been added to the laboratory's museum of local fauna, where it has already proved to be of great assistance in the task of identifying new material. Thanks are due to the following zoologists for the identification of the 1903 material: Professor C. C. Nutting (hydrozoa), Dr. W. R. Coe (nemerteans), Dr. J. P. Moore (annelids), Professor H. L. Clark (echinoderms), Dr. S. J. Holmes (amphipods), Dr. A. E. Ortmann (schizopods), Dr. Harriet Richardson (isopods), Dr. B. W. Evermann (fishes); and to the staff of the U. S. National Museum, for the determination of the molluscs and of several groups of crustacea. The task of identifying the tunicates has been undertaken by Professor W. E. Ritter, the barnacles by Professor M. A. Bigelow, and the bryozoa by Miss Alice Robertson. Thus far it has not been found possible to make any satisfactory disposition of the sponges.

As usual much general collecting was carried on by Mr. Vinal Edwards and others, the material thus obtained being turned over to investigators at the laboratory or preserved for future determination. Mr. Edwards kept his customary records of the fishes taken by trap or by seine.

During the present winter the task of compiling the results of the past two summers' dredging has been undertaken. The first step in this work consists in tabulating the distribution of each species by stations, and in plotting out these distribution areas upon suitable charts. By authorization of the commissioner, Mr. Chas. V. Morrill, of Columbia University, has been engaged to carry out this work, and a map will shortly be printed depicting the coast line of Vineyard Sound and Buzzards Bay, together with the dredging stations established therein, but lacking other details. It is intended that the distribution of each of the more important species shall be plotted upon a separate copy of this map.

Another chart, representing on a minute scale the topography of a small group of partially submerged rocks in Woods Harbor was constructed by Mr. F. W. Cushwa, under the direction of Dr. Davis. Printed copies of this chart will be employed for portraying annual and seasonal fluctuations in the distribution of various forms of marine life, particularly algæ.

III. CARD CATALOGUE RECORD OF LOCAL FAUNA AND FLORA.

Work upon this record has likewise been continued actively. During the spring of 1904 the notes hitherto abstracted from various sources were transferred in typewriting to catalogue cards, according to the system already described.* In all, 1,146 species were thus recorded, and upwards of 5,000 cards employed. The cata-

* SCIENCE, February 12, 1904.

logue, even in its present condition, has already proved its usefulness.

During the summer, Messrs. Max Morse, D. W. Davis and some of the other assistants completed, as far as was then practicable, the search for published data. The *Reports* and *Bulletins* of the U. S. Fish Commission, the *Transactions of the Connecticut Academy of Sciences,* the *Biological Bulletin,* the *American Naturalist* and the *Journal of Morphology,* together with the large collection of reprints contained in the library at the station, were systematically searched, and all relevant facts, even incidental references to the ecology of local species, were recorded. In all 84 papers were found to contain information of the sort desired, in addition to those abstracted during the preceding year.

There must also be mentioned a most valuable set of 113 cards in possession of the Marine Biological Laboratory, and kindly loaned by Dr. F. R. Lillie for incorporation into the present catalogue system. These cards record personal observations by various well-known investigators who have been connected with the Marine Biological Laboratory in past years. In addition, several zoologists generously prepared during the summer extensive sets of notes upon groups to which they had given especial attention. Mr. Lynds Jones furnished data relating to 104 species of marine and shore birds of the neighborhood; Professor Chas. B. Wilson furnished a set dealing with fifty species of parasitic copepods; Dr. W. R. Coe contributed notes relating to 32 local nemerteans and Dr. J. P. Moore prepared records of 25 species of polychæta. In addition valuable notes were received from Dr. A. L. Treadwell and Dr. Louis Murbach, dealing with polychæta and medusæ respectively.

It is needless to add that the data derived from the collecting work in progress will be incorporated as soon as they are made available.

IV. INDIVIDUAL INVESTIGATIONS.

Robert L. Baird, assistant in zoology and geology, Oberlin College, carried on experiments in the endeavor to determine the presence of sense of smell in *Fundulus,* to differentiate that sense from the sense of taste, and to ascertain the importance of the sense of smell to the fish in its life habits, especially in obtaining food.

E. N. Carter, superintendent U. S. Fisheries Station, St. Johnsbury, Vt., commenced experiments with view to testing the effect of temperature at the time of fertilization upon the subsequent development of fish eggs.

Leon J. Cole, Austin teaching fellow in zoology, Harvard University, assisted in the work of the biological survey, having supervision of the dredging operations of the *Fish Hawk* in Buzzards Bay.

Winterton C. Curtis, Ph.D., assistant professor of zoology, University of Missouri, was employed by the bureau to conduct experiments with a view to determining the life history of certain parasites of fishes. The attempt was made to find some treatment by which the 'sand shark,' *Carcharias littoralis,* could be freed of the cestode *Crossobothrium laciniatum,* which with rare exceptions infests the spiral valve of this fish. The 'oil of male fern,' commonly used as a vermifuge in veterinary and human practise, was tried and proved quite effective. In all some 56 sharks were subjected to the treatment with this drug and of these there were 38 survivors, of which 26 were without any infection, the remaining 12 being infected with *C. laciniatum* in much smaller numbers than one would expect to find in any untreated specimens. The 18 non-surviving specimens, of which some were killed because they seemed to be

dying, and others were examined soon after death from the treatment, showed evidence that all of the parasites had been killed by the drug before the death of the host. The best results in expurgation came from those cases in which the dose had been repeated after an interval of several days, but as this method was not perfected until late in the summer, it was impossible to apply it to more than a limited number of specimens. Hence these results do little beyond indicating that some continuation of the experiments will be necessary in order to determine a mode of treatment effective enough for practical use in expurgating sharks for experiments in artificial infection.

Infection experiments were carried out during 1903 and 1904 to find out what cestode develops from the *Scolex polymorphus* of the 'squeteague' (*Cynoscion regalis*), when these larvæ are fed to the sand shark. Each year a number of the sharks thus infected were found to contain large number of young *Phoreibothrium triloculatum Linton*, a cestode which is recorded from the 'dusky shark' (*Carcharinus obscurus*). Some evidence was obtained pointing to the conclusion that *Scolex polymorphus* likewise comprises larvæ which develop into the genus *Crossobothrium*, but this evidence is so inconclusive that it can have no value unless strongly confirmed by the results of futher investigation.

Bradley M. Davis, Ph.D., assistant professor of botany, University of Chicago, supervised the collecting and identifying of marine algæ in connection with the dredging work, being assisted in this task by Miss L. J. MacRae. Dr. Davis likewise commenced the compilation of a set of records of the marine plants of this region to be incorporated into the catalogue of local marine fauna and flora.

Donald W. Davis, student in Harvard University, assisted in the survey work, as well as in certain experiments with fishes to be described below.

Irving A. Field, Thayer Scholar, Harvard University, continued, as salaried assistant, his studies of the food of fishes of little or no food value, adding to the list of those investigated during the preceding summer the 'horned dog-fish' (*Squalus acanthias*), and the 'sand shark' (*Carcharias littoralis*). Experiments with view to determining the food value of the common dog-fish, and to discovering other possible economic uses, were likewise continued.

Frederic P. Gorham, Ph.D., associate professor of biology, Brown University, conducted, on behalf of the bureau, (1) bacteriological studies upon an epidemic disease of the menhaden then prevalent in Narragansett Bay and in certain parts of Buzzards Bay; (2) experiments, continued from the preceding year, upon the effects of various sorts of metal piping upon marine organisms kept in aquaria; (3) studies of certain properties of the blood of various marine animals.

Clarence W. Hahn, A.M., teacher of biology, New York High School of Commerce, carried on experiments upon the regeneration of *Holocampa, Metridium* and *Sagartia*, with view to discovering the causes that determine the growth of the directive mesenteries. Time was also spent in collaborating results already obtained on this subject.

Lynds Jones, M.S., instructor in zoology, Oberlin College, continued his studies upon the food of marine birds. The living birds were closely observed in their natural habitat, their method of fishing and of feeding their young being studied. The various local nesting grounds of the terns and gulls were visited, nine days being spent on Muskeget Island. Young gulls

and terns were brought back and studied in confinement for some weeks.

B. W. Kunkel, graduate student, Yale University, collected and carried on a preliminary study of the brains of eighteen species of elasmobranchs and teleosts of the locality, devoting his principal attention to the epiphysis.

Edwin Linton, Ph.D., professor of biology, Washington and Jefferson College, was engaged, on behalf of the bureau, (1) in working over a collection of entozoa from fish and fish-eating birds made by Mr. Vinal Edwards from September, 1903, to June, 1904, and contained in 300 vials; (2) in working over material collected during the current season by himself and an assistant, special attention being devoted to certain cestode parasites which were found in great numbers in the butter-fish (*Rhombus triacanthus*).

Lillian J. MacRae, teacher in South Boston High School, assisted Dr. Davis in the work of collecting and identifying marine algæ.

W. J. Moenkhaus, Ph.D., associate professor of physiology, Indiana University, repeated certain experiments of previous years in order to obtain material for further study of the behavior of chromatin in hybrids. The following crosses were made: (1) *Fundulus heteroclitus* ♀ × *Gasterosteus bispinosus* ♂, (2) *Fundulus heteroclitus* ♀ × *Stenotomus chrysops* ♂, (3) *Fundulus majalis* ♀ × *F. heteroclitus* ♂, (4) *Fundulus majalis* ♀ × *Tautogolabrus adspersus* ♂. An attempt to fertilize *Fundulus* eggs with the sperm of *Opsanus tau* was unsuccessful.

J. Percy Moore, Ph.D., instructor in zoology, University of Pennsylvania, made considerable progress with the synopsis of annelids of the Woods Hole region which he is engaged in preparing on behalf of the bureau, completing the families of Polynoidæ and Nereidæ, and drafting descriptions of species belonging to other families. The determination of the relations of the various sexual phases of the species of the latter family being a matter of considerable difficulty, the collection of suitable material for this purpose consumed much time. The life history of *Platynereis megalops* proved to be quite as complex as that of the classical *P. Dumerilii*, presenting, however, some important differences. With the exception of *Nereis arenaceodentata*, heteronereids of all the species have been found. An additional new species of *Nereis* was also discovered. The Polynoidæ and other scaly polychæta are of well-known species, though several new to the region have been found. The large felted polychæte, commonly called the 'sea mouse,' of American waters, has always been identified with the European *Aphrodite aculeata*. A careful study of specimens taken off Nantucket and Marthas Vineyard show that the species occurring there is quite distinct. The dredging operations connected with the biological survey resulted in large collections of polychæta, the determination and recording of which required much time. Besides adding several forms to the known fauna of the region, the most interesting of which is the remarkable *Spiochætopterus oculatus*, this work has added greatly to our knowledge of the local distribution of certain species.

Max Morse, fellow in zoology, Columbia University, assisted in the work of the biological survey, as well as in biometric studies carried on by Dr. Sumner.

Raymond C. Osburn, teacher of biology, New York High School of Commerce, assisted in the work of the biological survey, having supervision of the dredging operations of the *Phalarope*.

George H. Parker, Ph.D., assistant professor of zoology, Harvard University, continued, as salaried investigator, his experiments of a previous summer upon the hearing of fishes, devoting especial attention to the functions of the ear of the squeteague (*Cynoscion regalis*). The latter consists of a dorsal utriculus, with three semi-circular canals, and of ventral sacculus containing a large otolith. The cavity of the utriculus does not communicate with that of the sacculus; hence the ear of this fish, unlike that of most vertebrates, is represented anatomically by two separate parts. When the utriculi and their appended semi-circular canals and nerves were cut, the fishes showed characteristic disturbances in their equilibrium, and these disturbances persisted till death. Such fishes were as responsive as normal ones to sound vibrations produced by tapping with a mallet on the side of the wooden aquarium in which they were kept. When the otoliths, which are normally quite freely movable in the sacculi, were pressed by means of pins against the outer, non-nervous sides of their chambers and were thus fastened, the fishes showed no disturbance of equilibrium, but did not react to sound vibrations as do normal fishes. It, therefore seems probable to Dr. Parker that the utriculus and the semicircular canals are sense organs concerned with equilibrium, and that the sacculus with its contained otolith is an organ of hearing.

Henry F. Perkins, instructor in zoology, University of Vermont, and Carnegie research assistant, continued his endeavors to rear the eggs of *Gonionemus murbachii*, with view to a study of the embryology of this form. This task has proved extremely difficult in the past, but preliminary steps were successfully taken. Towing collections of various hydromedusæ were also made from the wharf, furnishing material for a study of the formation of new tentacles.

L. Charles Raiford, instructor in chemistry and dyeing, Mississippi Agricultural College, carried on studies upon the intestinal bacteria of certain fishes. Cultures were taken from 57 dog-fish and 26 menhaden, and those organisms which appeared to be of constant occurrence were isolated in pure culture. So far as his work has been carried, Mr. Raiford believes that all of the bacteria found are commonly known species.

H. W. Rand, Ph.D., instructor in zoology, Harvard University, collected and prepared material for studies of the venous system of the skate. Injections were made of the hepatic portal, cardinal and lateral veins, with a view to determining the relations and connections of these several systems of veins in the posterior region of the abdominal cavity. Dr. Rand also made a series of observations on the respiratory movements of the skate, with special reference to the functions of the spiracle.

George G. Scott, M.A., tutor in philosophy, College of the City of New York, and assistant in charge of the supply room at the laboratory, carried on studies upon the sporozoa parasitic in various marine invertebrates.

Grant Smith, Ph.D., teacher of biology, Chicago Normal School, collected and prepared material for the study of the eyes of various marine invertebrates.

W. L. Sperry, Rhodes scholar elect, carried on studies upon the muscular and nervous systems of the star-fish, *Asterias forbesi*. In this work Mr. Sperry assisted Professor H. L. Clark, who, however, was not himself present this season. Certain features of the musculature were studied in detail and drawn, observations upon the movements of the living animal were made,

and experiments were made to determine suitable methods of staining.

M. X. Sullivan, Ph.D., instructor in chemical physiology, Brown University, investigated the physiology of digestion in the common dog-fish.

Francis Bertody Sumner, Ph.D., instructor in zoology, College of the City of New York, and director of the laboratory, was occupied with (1) work upon the biological survey of the marine fauna and flora of the vicinity of Woods Hole (*see above*), (2) the card catalogue record of local species (*see above*), (3) experimental and statistical studies of various fishes with reference to adaption and selection. In the experimental part of this work, Dr. Sumner was assisted by Mr. D. W. Davis, in the biometric part by Messrs. Davis, Metcalf, Morse and some other assistants.

E. E. Watson, student in Iowa University, was engaged in biometric studies of various local crabs.

Chas. B. Wilson, A.M., professor of biology, State Normal School, Westfield, Mass., carried on studies of parasitic copepods, both living and preserved material being used. Many interesting facts relating to the ecology of these parasites, some of possible economic value, were discovered. In a number of cases the life history was traced partially or completely. A considerable number of new species were found. Professor Wilson likewise prepared an extensive set of records of local parasitic copepods for incorporation into the faunal catalogue.

Commissioner G. M. Bowers, Dr. B. W. Evermann, chief of the Division of Scientific Inquiry, and Mr. E. L. Goldsborough, assistant in that division, likewise spent portions of the summer at the station; and the hospitality of the laboratory was extended to Mr. Chas. R. Knight, the well-known animal painter, and to Mr. S. F. Denton, the illustrator and taxidermist.

Francis B. Sumner.

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*ALBATROSS EXPEDITION TO THE EASTERN PACIFIC.**

II.

We left Callao for Easter Island Saturday afternoon, December 3; as far as 90° west longitude we remained in the Humboldt current, as we could readily see from the character of the temperature serials and from the amount of pelagic life we obtained from both the surface and the intermediate hauls. This current also affected the bottom fauna, which was fairly rich even as far as 800 miles from the shore while we remained within the limits of the northern current. As soon as we ran outside of this the character of the surface fauna changed; it became less and less abundant as we made our way to Easter Island, the western half of the line from Callao becoming gradually barren. This current also affected the deep-sea fauna to such an extent that towards Easter Island, at a distance of 1,200 to 1,400 miles from the South American continent, our trawl hauls were absolutely barren; the bottom for the greater part of the line was covered with manganese nodules on which were found attached a few insignificant siliceous sponges, an occasional ophiuran, and a few brachiopods or diminutive worm tubes, the same bottom continuing to Sala y Gomez and between there and Easter Island. Sala y Gomez and Easter Island are connected by a ridge, on which we found 1,142 fathoms near Sala y Gomez, and 1,696 fathoms between that point and Easter Island. The ridge rises rapidly from about 2,000 fathoms, the general oceanic depth within about

* Extract from a letter of Mr. Alexander Agassiz to Hon. George M. Bowers, U. S. Fish Commissioner, dated Chatham Island, Galapagos, January 6, 1905.

100 miles, to over 1,100 fathoms within a comparatively short distance from both Sala y Gomez and Easter Island.

The southern part of our line from Easter Island to the Galapagos shows all the features characteristic of the western part of the line from Callao to Easter Island; like the latter, as far as the twelfth degree of southern latitude, it proved comparatively barren, the bottom consisting of manganese nodules to within about 250 miles of the Galapagos. The pelagic and intermediate fauna from Easter Island to 12° south latitude was very poor, and the serial temperatures show that we were outside and to the westward of the great Humboldt current. But near the twelfth degree of southern latitude a sudden change took place; the pelagic and intermediate fauna became quite abundant again, and soon fully as rich as at any time in the Humboldt current. There was also a marked change in the temperature of the water as indicated by the serials, showing that from the twelfth degree of southern latitude to the Galapagos we were cutting across the western part of the Humboldt current. The great changes of temperature which took place in the layers of the water between 50 and 300 fathoms are most striking, and show what a disturbing element the great mass of cold water flowing north must be in the equatorial regions of the Panamic district to the south and to the north of the Galapagos. South of the Galapagos the western flow of the Humboldt current must be nearly 900 miles wide, and of about the same width when running parallel to the South American coast.

The range of temperatures between 30 fathoms and 150 fathoms is at some points as great as 21°. Such extremes can not fail to affect the distribution of the pelagic fauna, and may account for the mass of dead material often collected in the intermediate tows at depths of less than 300 fathoms, when the range becomes as great as 28°. Such a range of temperature is far greater than that of the isocrymic lines which separate coast faunal divisions. The bottom fauna, as we entered the Humboldt current going north, gradually became richer in spite of its being covered with manganese nodules.

The two lines centering at Easter Island developed the Albatross Plateau indicated on the *Challenger* bathymetrical charts, on the strength of a few soundings reaching from Callao in a northwesterly direction and of a couple of soundings on the twentieth degree of latitude. The Albatross Plateau is marked as a broad ridge separating the Buchan Basin from the deep basin to the westward, of which Grey Deep and Moser Basin are the most noted areas.

Our line from Easter Island to the Galapagos showed a wonderfully level ridge, varying in depth only from 2,020 to 2,265 fathoms in a distance of nearly 2,000 miles. The soundings we made to the eastward from the Galapagos to the South American coast, and to the westward of Callao, as well as on the line from Callao to Easter Island, all indicate a gradual deepening to the eastward to form what the *Challenger* has called the Buchan Basin, with greatest depths of 2,400 to over 2,700 fathoms, and passing at several points near the coast to Milne-Edwards Deep, Haeckel Deep, Krümmel Deep and Richards Deep, some of them with a depth of over 4,000 fathoms. According to the *Challenger* soundings the Juan Fernandez Plateau connects with the Albatross Plateau and forms the southern limit separating Buchan Basin from the Barker Basin to the south of the Juan Fernandez Plateau.

At Easter Island we found our collier awaiting our arrival. We moved from Cook Bay to La Pérouse Bay to coal, as there was less swell there than in Cook Bay,

where we could scarcely have gone alongside for this purpose.

Considerable shore collecting was done at Easter Island. We must have brought together at least thirty species of plants. The flora of Easter Island is very poor. There are no trees nor native bushes—not even the bushes which characterize the shore tracts of the most isolated coral reefs of the Pacific are found there; and yet some of the equatorial counter-currents must occasionally bring some flotsam to its shores. We collected a number of shore fishes and made a small collection of the littoral fauna. The fishes have a decided Pacific look, and the few species of sea-urchins we came across are species having a wide distribution in the Pacific.

While coaling, we spent some time examining the prehistoric monuments which line the shores of Easter Island. During our stay at La Pérouse Bay we visited the platforms studding the coast of the bay, and made an excursion to the crater of Rana Roraka, where are situated the great quarries from which were cut the colossal images now scattered all over the island, many of which have fallen near the platforms upon which they were erected. Near Rana Roraka, at Tongariki, is the largest platform on the island, about 450 feet in length, to the rear of which are fifteen huge images which have fallen from the pedestals upon which they once stood. The plain in the rear of the platform is crowded with stone houses, most of which are in ruins.

On our return to our anchorage at Cook Bay, we examined the platforms within easy reach of the settlement, and also the crater of Rana Kao, on the north rim of which, at Orongo, are a number of the stone houses built by the people who quarried the great stone images. At Orongo are also found sculptured rocks, but neither the sculptures nor the images show any artistic qualities, though the fitting of some of the cyclopean stones used in building the faces of the platforms indicate excellent and careful workmanship. To Mr. C. Cooper, manager of the Easter Island Company, we are indebted for assistance while visiting the points of interest of the island. He was indefatigable in his exertions in our behalf.

We took a number of photographs during our stay, illustrating not only the prehistoric remains, but giving also an idea of the desolate aspect of Easter Island during the dry season.

We arrived at Wreck Bay, Chatham Island, Galapagos, on the third of January, where we found a schooner with a supply of coal. As soon as the ship has been overhauled and coaled we shall start for Manga Reva, where we ought to arrive the last days of January. We reached Chatham Island towards the end of the dry season. Everything is dried up, the vegetation seems dead with the exception of a few small wild cotton plants, weeds, cactus and an occasional mimosa; and the great barren slopes present fully as uninviting an aspect as when Darwin described them. When the *Albatross* visited the Galapagos in March, 1891, everything was green, presenting a very marked contrast to its present desolate appearance.

Alexander Agassiz.

SCIENTIFIC BOOKS.

Problems in Astrophysics. By Agnes M. Clerke. London, Adam and Charles Black; Agents in America, The Macmillan Co. 1903. Pp. xvi + 567, with 81 illustrations. $6.00 net.

Qualified by her authorship of those excellent works 'The History of Astronomy in the Nineteenth Century' and 'The System of the Stars,' and by her obviously minute and critical study of current research in this field, Miss Clerke presents in her latest work a lucid account of pending problems in astrophysics.

Her brilliant style of writing is maintained throughout, and is sure to fascinate even the reader who does not fully comprehend her meaning. Sometimes, indeed, her lavish use of synonyms must puzzle those not familiar with the subject; but it carries her and her readers lightly and pleasantly over some chapters that would certainly be dry in the hands of most authors.

The keynote of the book is suggestiveness, as the author points out in the preface, and there could be no better tribute to her success in this respect than the use made of her work by astronomers. She clearly differentiates the known and the unknown, and emphasizes what ought to be found out.

The book can be commended to the attention of the physicist and the chemist. It is unfortunate that so few workers in the field of chemistry seem to take a positive and active interest in the problems of astrophysics; for in many respects its progress is being delayed while developments are awaited from the chemical laboratories. When these developments come, as when Ramsay solved the mystery of helium, the forward movement is rapid. Students of electricity also ought to find considerable of interest in this book and its topics, for our nearest approaches to laboratory representations of stellar phenomena seem to be of an electrical character. Yet we really do not know at all how these electrical phenomena can be brought into their proper relation to the thermal conditions which doubtless obtain in the stars.

The work before us is divided into two parts, 'Problems in Solar Physics' and 'Problems in Sidereal Physics,' the second part occupying something more than two thirds of the volume. The fourteen chapters of the first part deal with the sun's chemistry, and separately with its successive envelopes. Two chapters are devoted to sun-spots, and they sufficiently disclose our ignorance as to the nature and cause of these familiar but no less puzzling phenomena. The last three chapters treat of the solar rotation, the solar cycle and 'the sun as a whole.' The author's point of view is the safe and conservative one which has been taught by Young and by Huggins. Schmidt's refraction theory of solar phenomena is regarded as largely of academic interest. The general reader may safely accept the author's comments as well balanced; and there is no concealment, but rather a frank avowal, of the extent of our present ignorance on the problems of the sun.

Part II. includes forty-one chapters and enters into the personal details—the *vie intime*—of the stars, possibly rather too minutely for the general reader. But it is decidedly interesting reading, and the reviewer must confess that the belatedness of this review is due to the tendency to peruse these details repeatedly to the detriment of obtaining a broad survey of the book. The author adopts a rather simple scheme for classifying stellar spectra and gives to each class a chapter. Anomalous and bright-line spectra receive an ample treatment. Spectroscopic binaries and eclipsing stars also get considerable attention. 'The problem of Beta Lyræ' occupies a chapter of twenty pages, while the longest chapter is devoted to temporary stars, including Nova Persei. After clusters have been discussed, the nebulæ are taken up in nine interesting chapters, and few of the objects of this class which have been carefully studied are omitted in the author's detailed treatment. A brief final chapter discusses the physics of the Milky Way.

References to the original sources are faithfully given throughout the work, and apparently with few typographical errors, from which the book is otherwise quite free. We wish that Miss Clerke would adopt the use of the convenient word spectrogram instead of making *spectrograph* serve for both the instrument and the photographic result of its use. Slips of the pen seem to be rare, and there are few points at which a conservative reader would interpret the results of observations very differently from the author.

The thirty-one insert plates are for the most part excellent. Those printed in the text, except diagrams, are less satisfactory, notably the picture of prominence on p. 104. The light weight of the paper makes the handling of the book a pleasure—and it is likely to

be handled rather frequently by many of its owners.

Edwin B. Frost.

Yerkes Observatory.

La Montagne Pelée et ses Eruptions. Par A. Lacroix. Ouvrage Publié par l'Académie des Sciences sous les Auspices des Ministères de l'Instruction publique et des Colonies, Paris. 1904. Pp. xxii + 662. 30 plates and numerous text figures.

The most complete report on Martinique yet published is that of Professor Lacroix, which embodies the results of his researches during two extended sojourns in the West Indies. Few geologists were better qualified to undertake the task and unusual facilities were offered him to make as exhaustive an examination as the conditions would permit of the volcano Pelée.

Professor Lacroix was sent, at the suggestion of the Académie des Sciences, by the Minister of the Colonies at the head of a scientific commission to study the effects of the eruption of Pelée and to examine into its causes. The commission consisted, in addition to Professor Lacroix, of M. Rollet de l'Isle and M. Giraud. After a preliminary visit of little more than a month in June and July, 1902, the party returned to France to arrange for a longer visit in the dry season. The eruption of the thirty-first of August hastened Professor Lacroix's departure and he arrived a second time at Fort de France on the first of October alone, the other members of the mission being unable to accompany him. During this second visit, which lasted nearly six months, the greater part of the material was gathered upon which the present report is based.

Two observatories were established from which the volcano could be watched day and night, and at these posts were cameras and various instruments for the purpose of recording with as minute detail as possible all events, or changes in the form of the mountain. The results of these observations were correlated by Professor Lacroix, who devoted a greater part of his own time to an examination of the volcano, the collection of specimens, and to obtaining, if one may judge from the illustrations of the book, a large number of very remarkable photographs.

In presenting his results Lacroix has arranged them under three heads: The first part, which is by far the longest, deals with the geological and physical problems involved in the eruptions, and contains detailed descriptions of the more violent outbreaks. The second part is devoted to a petrographical study of the actual products of the eruption and to a comparison of these with rocks from the other islands of the Lesser Antilles. In the third part, the various products resulting from the conflagration of Saint Pierre are discussed, particular attention being paid to the secondary minerals developed and the effect of intense heat on the old andesite of which most of the houses were built.

Much of the information contained in the first part will be familiar to those who have followed Lacroix's earlier reports and the descriptions of the American observers, but certain chapters are of unusual interest to geologists, especially those which deal with the processes involved in the formation of the famous 'dome' and 'spine,' the theory of the 'burning clouds' (nuées ardentes) of the more violent eruptions, the deposits of fragmental materials, and the various secondary phenomena. After summarizing in chapter I. of the first part the geology of Martinique and the other Antillean islands, and describing earlier eruptions, the author calls attention in chapter II. to the single center of eruption and the absence of secondary vents. A study of the modifications in topography resulting directly from the great eruptions shows them to have been relatively slight, from a geological point of view, when compared with the devastation wrought. Judging from the records of cable repair ships no marked changes in submarine topography occurred and the breaking of the cables is attributed to the shelving of deltas at the mouths of streams descending from the flanks of Pelée.

In chapter III. Lacroix describes the evolution of the 'dome' and offers an explanation of the processes involved in its development. Briefly, the 'dome' is the eminence which has

appeared within the old crater (Etang Sec) since the eruption of May 8, 1902, and which was considered by some of the American observers as merely a secondary cinder cone, or an accumulation of fragmental ejected material about the actual vent. Lacroix denies that it is of fragmental nature and states that it is, in fact, a homogeneous mass of viscous lava surrounded by an envelope of the same substance cooled and consolidated. The explanation of this phenomenon and of the remarkable spine of solid rock which has from time to time risen above the dome itself is essentially as follows:

The viscous magma on reaching the surface through the throat of the volcano and forming a protuberant mass is quickly surrounded by a solid shell or envelope which protects the still pasty interior from a too rapid cooling. This envelope becomes fissured, under the influence of progressive solidification, and the increase in volume of the mass itself, and through the clefts thus formed fresh molten material is exuded. In this way a homogeneous rocky mass increases in height and volume, bristling with jagged points, glowing like a 'charcoal-burner's fire' at night, and bounded by abrupt walls which rise from the debris accumulating at its base from incessant superficial crumbling. Projected materials resulting from violent eruptions play but a small part in the constitution of such a dome. A dome so constructed is not characterized by any permanent vent or crater, but violent eruptions determine such openings, which are of a temporary nature and rapidly closed. When the envelope has become sufficiently resistant to permit no longer a growth in all directions, the action of the pressure is localized at certain points and results in the extrusion of solid rocky masses issuing as from a mold and producing needles or spines which may attain an elevation of several hundred meters. In the course of a single eruption the point at which the pressure concentrates itself may be displaced, and successive spines may result of diverse forms, dimensions and positions, and often of an ephemeral existence, for continual crumbling tends to modify or totally destroy them. This process, which has been unrecognized up to the present, and which Lacroix is the first to describe, explains, in his opinion, the origin of the many peculiarities of structure of 'domes' in volcanic regions where activity no longer is manifest, and which have often been assumed to be the cores of dissected volcanoes.

Four types of rock were recognized as constituting the dome and spine, the specimens being collected from the talus extending down the Rivière Blanche from the base of the dome, and from the edge of the old crater after violent eruptions. The four types are differentiated by the character of their groundmasses, the phenocrysts being the same; they are essentially hypersthene andesites. Rocks of the first two types are glassy, the first being obsidian, the ground-mass of the second containing a few microlites of an acid plagioclase in a glassy base. The third type is a porous or vesicular andesite containing greater or less amounts of plagioclase microlites in the ground-mass; the fourth type differs but little from the third except that the groundmass contains quartz in small crystals frequently abundant enough to make the rock microgranular. Of these four types I. and II. are believed to have been derived from the shell or envelope of the dome, type I. probably representing the original crust, and type II. the material filling the cracks and fissures in the outer shell. Rocks of these types are abundant in the ejectamenta of violent eruptions. Specimens of types III. and IV. were obtained from the quiet crumbling or breaking down of the spine. The quartz-rich rocks are assumed to have come from the interior of the spine and are the result of a much slower cooling of the magma, while rocks of type III. represent a somewhat more rapid cooling. In commenting upon these quartzose andesites, Lacroix says: "* * * The actual production of quartz-bearing rocks, more or less completely microgranular, which I consider one of the most important observations that I had occasion to make, shows that the conditions necessary for the formation of quartz in a volcanic rock may be realized at slight depth under the solidified outer shell of a dome of acid rock in process of evolution" (page 157).

In part II., on petrography, this matter is taken up in greater detail and the conditions controlling the crystallization of quartz discussed. The microlites of feldspar and the metasilicates like the phenocrysts are essentially the products of igneous fusion, but the quartz is assumed to have crystallized under hydrothermal conditions acting at a lower temperature. These opinions are especially significant, coming as they do from one of the foremost French petrographers.

Chapter IV. deals with the most evident and apparent expressions of vulcanism—the great clouds of vapor ladened with fragmental material, the 'burning clouds' (nuées ardentes) which swept down the flanks of Pelée and annihilated Saint Pierre, mud-flows, etc. Several chapters follow in which the different violent eruptions are described and the theory of the 'burning clouds' is discussed. Chapter IX. is an important one on the character and distribution of the fragmental deposits and their subsequent erosion. The first part closes with an account of the various accessory phenomena, as atmospheric electricity, changes in atmospheric pressure, abnormal optical phenomena, etc.

Part II. consists of a systematic petrographical study of the recently erupted rocks in which, it is interesting to note, the author makes frequent use of the Quantitative System recently proposed by Cross, Iddings, Pirsson and Washington, finding it most convenient for purposes of comparison. The mineral composition and texture of the rocks are described, and the conditions already mentioned, which have influenced the consolidation of the magma, are discussed in detail. The older rocks of Martinique and a number from other islands of the Lesser Antilles are compared, and a consideration of their chemical composition leads to the recognition of a well-marked petrographic province.

In part III. Lacroix presents the results of his observations on the products resulting from the burning of Saint Pierre. The effect of intense heat on metals, glass, structural stone-work, etc., was often sufficient to cause complete fusion, leading to the formation of a considerable variety of secondary minerals.

The book bears evidence in places of hasty preparation and there is considerable needless repetition, but, on the whole, it must be recognized as the most complete and masterly presentation that has yet appeared of the facts and problems related to the West Indian eruptions of 1902–3. The promptness with which the final report was published after the close of the field work deserves praise in itself, and too much can not be said of the excellence of the numerous illustrations which, with very few exceptions, are from untouched photographs and are faithful records of the events from soon after the disaster of May 8, 1902, until the autumn of 1904.

Ernest Howe.

Washington, D. C.,
March 22, 1905.

SCIENTIFIC JOURNALS AND ARTICLES.

The February number (volume 11, number 5) of the *Bulletin of the American Mathematical Society* contains the following articles: Report of the Eleventh Annual Meeting of the American Mathematical Society, by F. N. Cole; 'Mathematical Progress in America' (Presidential Address), by T. S. Fiske; Report of the Sectional Meetings of the Heidelberg Congress (Continuation), by E. B. Wilson; Report of the Breslau Meeting of the Deutsche Mathematiker-Vereinigung, by R. E. Wilson; 'The Construction of Conics under Given Conditions,' by M. W. Haskell; Notes; New Publications.

The March number of the *Bulletin* contains the following articles: 'The Present Problems of Geometry,' by Edward Kasner; Report of the Fifty-fourth Annual Meeting of the American Association for the Advancement of Science, by L. G. Weld; 'A Calculus for Geometers' (Review of Humbert's Cours d'Analyse), by E. R. Hedrick; 'Halsted's Rational Geometry' (Review), by S. C. Davisson; 'Tchebychef's Theory of Congruences,' by André Markoff; Notes; New Publications.

The American Naturalist for February opens with an article by J. S. Kingsley, on 'The Bones of the Reptilian Lower Jaw,' showing the presence of an element, the derm-

articulare, which sometimes remains distinct, but more often fuses with the articulare. Other articles are 'Natural and Artificial Parthenogenesis,' by Alexander Petrunkevitch; 'The Angle of Deviation from the Normal Vertical Position at which Stems show the Strongest Geotropic Response,' by Julia A. Haynes (a difficult title for the cataloguer), and 'Note on the Variation in the Bay Flowers of Rudbeckia,' by Raymond Pearl.

The Popular Science Monthly for April contains a most important article, 'The Menace to Niagara,' by John M. Clarke, showing the entire probability that the American Falls will be destroyed if present plans are carried out. Other articles are 'Sunspots and Weather,' by Ernest W. Brown; 'Medical Research, its Place in the University Medical School,' by Theobald Smith; 'The Problem of Immigration,' by Allan McLaughlin; 'Age and Eminence,' by Edwin G. Smith; 'Authority in English Pronunciation,' by Edwin W. Bowen, which shows the part dictionaries play in fixing the pronunciation of words, and, finally, 'The Bermuda Islands and the Bermuda Biological Station for Research,' by Edward L. Mark. In correspondence Olivia R. Fernow discusses the question 'Does Higher Education Unfit Women for Motherhood' in reply to the somewhat hysterical article by Dr. Smith in March. The number completes Volume LXVI. and has the index.

SOCIETIES AND ACADEMIES.

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY.

THE regular meeting of the section was held on Monday evening, January 8, at Fayerweather Hall, Columbia University.

The following papers were presented:

Experiments Relating to the Conductivity of Powders at High Temperatures: HERSCHEL C. PARKER.

When a conducting powder like graphite is mixed with a non-conducting refractory powder, the resistance increases quite rapidly at first; as the proportion of graphite is decreased, then more slowly, and after a time reaches a critical point where there is no conduction or the graphite is destroyed by arcing.

When the percentage of the conducting powder is low a mechanical separation or 'striation' takes place on packing in the refractory tubes. Besides this an electrolytic separation usually takes place after a time and the conductivity of the mixture is destroyed by arcing.

A very great variety of substances and mixtures were experimented with in the search for a permanent compound of high resistance.

The Magnetic Susceptibility of Water: A. P. WILLS.

Experiments were made with the large electro magnet of Columbia University to determine the magnetic susceptibility of water. With the aid of this magnet, which is one of the largest in existence, Dr. Wills found the coefficient of susceptibility of water to be -0.72×10^{-6}, and also to be independent of the field strength over a range from 4,000 to 16,000 C.G.S. units.

C. C. TROWBRIDGE,
Secretary.

SECTION OF BIOLOGY.

AT the March meeting papers were presented by Mr. L. I. Dublin, of the College of the City of New York; Mr. Frederic A. Lucas, director of the Brooklyn Museum; and Professor F. S. Lee, of Columbia University.

Mr. Dublin described the history of the germ-cells in *Pedicellina americana,* giving special attention to the chromatic changes. The somatic number of chromosomes is twenty-two. These bodies behave, throughout, very much as has been described by many workers on other forms; but in addition there has been observed a peculiar process in connection with the reduction of the chromosomes. These are V-shaped in the somatic cells and in the several generations of oogonia and spermatogonia, with the exception of what appears to be the last. In this the number is still twenty-two, but they are bar-shaped. These divide and, either before or at the telophase, apparently unite end to end in pairs to form eleven new V's, each bivalent as compared with the earlier

structures. A longitudinal splitting of these loops, coincident with the extensive growth of the individuals, produces in the first maturation division eleven ring- or bar-shaped chromosomes each of which is structurally a tetrad. The first division is thus reducing; the second, equational. The change in chromosome form in the last oogonial and spermatogonial generations is then clearly a striking adaptation to the subsequent synapsis or reduction, making the latter easily possible.

Mr. Lucas gave an account of whales and whaling on the coast of Newfoundland, illustrating his remarks with stereopticon views of the whales and stages of their capture. Three species of whales were described, the finback, the humpback and the sulphur-bottom, the first two being found on the south and east coast, the last one on the south coast only. The speaker then described the past and present methods of capture and utilization, saying that whales are now worked up so rapidly that within forty-eight hours after one is brought to the whaling station, it is reduced to oil, fertilizer and bone. The lecture closed with an interesting account of the method employed in making the mold of the large model of a whale shown by the National Museum in the exhibit at St. Louis. This was possibly the largest mold ever made, and the cast was the first accurate representation of a fully grown whale.

Professor Lee discussed 'Temperature and Muscle Fatigue.' He and others have previously pointed out that the contraction process of the muscles of cold-blooded animals in the course of fatigue becomes greatly slowed, while those of warm-blooded animals show no such phenomenon. Lohmann has recently claimed that a cold-blooded muscle on being heated to mammalian temperature shows a course of fatigue similar to that of mammalian muscle; and, on the other hand, that a warm-blooded muscle on being cooled fatigues like the muscles of cold-blooded animals at a similar temperature. From these supposed effects he infers that in the matter of fatigue there is no real physiological difference between the two groups of muscle. Professor Lee has not been able to confirm Lohmann's conclusions. Every variety of muscle which has been tested, whether of cold-blooded or warm-blooded animals, shows its characteristic method of fatigue, whatever the temperature may be. The original conclusion regarding the difference between the two groups of muscles seems, therefore, to be justified.

M. A. Bigelow,
Secretary.

The Society for Experimental Biology and Medicine.

The tenth regular (second annual) meeting of the Society for Experimental Biology and Medicine was held in the Rockefeller Institute for Medical Research, on Wednesday, February 15. The president, Dr. S. J. Meltzer, was in the chair.

Members Present.—Atkinson, Auer, Burton-Opitz, Dunham, Ewing, Flexner, Gies, Jackson, Lee, Levene, Levin, Mandel, Meltzer, Noguchi, Norris, Oertel, Opie, Park, Richards, Sweet, Wadsworth, Wallace, Wolf, Yatsu.

Members Elected.—George W. Crile, Haven Emerson, Cyrus W. Field, Hideyo Noguchi, H. C. Sherman, J. Edwin Sweet, Victor C. Vaughan.

Officers Elected.—President: Edmund B. Wilson; *Vice-President:* Edward K. Dunham; *Librarian:* Graham Lusk; *Treasurer:* Gary N. Calkins; *Secretary:* William J. Gies.

*Abstracts of Reports of Original Investigations.**

Degrees of Susceptibility to Diphtheria Toxin Among Guinea-pigs. Transmission from Parents to Offspring: Theobald Smith. (Presented by William H. Park.)

Dr. Smith called attention to the usefulness of the antitoxin unit, furnished by the Institute for Experimental Therapy under the direction of Professor Ehrlich, in the routine testing of the strength of diphtheria antitoxin. The one uncertain element is the relative re-

* The abstracts presented in this account of the proceedings have been greatly condensed from abstracts given to the secretary by the authors themselves. The latter abstracts of the reports may be found in current issues of *American Medicine* and *Medical News*.

sistance of the guinea pigs to diphtheria toxin. Irregularities in the routine tests during the past year led the author to look up the genealogy of the pigs used, and he found that the different degrees of resistance belonged to certain families or litters, and were constant for those families. Thus one mother gave birth to young which did not react to what was the usual fatal dose. Four successive litters possessed the same resistance. It appeared probable that this family could stand 40 per cent. more toxin, when mixed with the antitoxic unit, than those of average susceptibility.

It would seem from these and similar observations that different degrees of susceptibility to toxin are to be found among guinea pigs and that the special degree possessed by any one is not to be attributed to individual variation, but to a family trait or character. Experiments are now under way to determine the part played by the male in the transmission of toxin-resistance.

The Protective Action of Venom upon Blood Corpuscles, with demonstrations: HIDEYO NOGUCHI. (Presented by Simon Flexner.)

That concentrated solutions of venom fail to destroy and tend to preserve blood corpuscles was noted by Mitchell and Stewart. The conclusion which has been reached by the author is that venom unites with the globulins, and especially with the hemoglobin, of the red corpuscles, yielding a water-insoluble compound to which the protection is due. Various substances, but only salts, acids and alkalies, restore the hemolyzability of the corpuscles by dissolving the venom-hemoglobin compound. The permeability of the corpuscles is not markedly altered.

The Results of Attempts to Cultivate Trypanosomes from Frogs: JOSEPH LEWIS and HERBERT U. WILLIAMS. (Presented by Augustus B. Wadsworth.)

Examinations of the blood of various lower animals were made at Buffalo, N. Y., in search of parasitic protozoa. The results were negative in dogs, cats, rabbits, guinea-pigs, English sparrows, toads and mud-puppies (*Necturus maculatus*). In frogs from the Niagara River hematozoa were found quite frequently, viz., *Trypanosoma, Drepanidium* and in one case *Filaria. Trypanosoma* was seen only in midsummer.

Attempts were made to cultivate *Trypanosoma* and *Drepanidium,* using a modification of the blood-agar medium, proposed by Novy and MacNeal. Trypanosomes from the frog may be cultivated on blood-agar, but, in the experience of the writers, with considerable difficulty.

From a frog infected with *Tr. rotatorium* a flagellate organism was cultivated, showing important points of difference from *Tr. rotatorium.* It is possible that, owing to the technical difficulties of the experiment, some other organism may have found its way into the tubes. This is improbable.

Undoubted trypanosomes developed in blood-agar prepared from a frog whose blood, during life, showed no trypanosomes, so that they must have been present in very small numbers or in some unrecognized form. They resembled *Tr. rotatorium,* but were usually much smaller. As this blood-culture-medium was inoculated with blood from another source containing *Drepanidium,* it nearly led to the conclusion that *Trypanosoma* might develop from *Drepanidium.* We have here an illustration of the ease with which mistakes may occur in the cultivation of hematozoa which are suspected of passing through cycles. Such a possibility had been pointed out in advance by Novy and MacNeal before this society (October, 1904).

There was no evidence from the experiments to show that development of *Drepanidium* can occur in blood-agar.

Experimental Measles: LUDWIG HEKTOEN. (Presented by Eugene L. Opie.)

The results of two experiments on adult men permit the conclusion that the virus of measles is present in the blood of patients with typical measles some time at least during the first thirty hours of the eruption; furthermore that the virus retains its virulence for at least twenty-four hours when such blood is inoculated into ascites-broth and kept at 37° C. This demonstration shows that it is not difficult to obtain the virus of measles un-

mixed with other microbes and in such form that it may be studied by various methods.

The Formation of the Centrosome in Enucleated Egg-fragments: Naohidé Yatsu.

To test whether the centrosome is a permanent cell-organ or not, Wilson (1901) treated, with a salt solution, enucleated egg-fragments (sea-urchin) obtained by shaking. He observed that asters containing centrioles and capable of division were produced in this way in the enucleated fragments. At Wilson's suggestion the author tried the experiment in a somewhat different manner. Eggs of *Cerebratulus* were used. Individual eggs were cut into *nucleated* (*i. e.*, containing the first maturation mitotic figure) and *enucleated* fragments. The latter were kept for an hour in a solution of calcium chlorid. Then they were transferred to sterilized sea-water. Asters were produced in almost all enucleated fragments thus treated. All the asters had centrioles which were identical with those found in the whole eggs subjected to the same treatment. The nucleated half was stained and was shown to have had two original centrosomes intact. From the results of these experiments no other conclusion can be drawn than that the centrosome, with centriole, of the enucleated fragment was in each case formed *de novo*—a complete confirmation of Wilson's original deduction.

In these experiments strict precautions were taken to prevent accidental fertilization.

Structure of Vaccine Bodies in Isolated Cells, with demonstrations: James Ewing.

In Klatsch preparations of corneal vaccine ulcers stained by Nocht's method, the vaccine body is seen to be a portion of the cytoreticulum, its reticular structure being continuous on the one hand with the cytoreticulum and on the other usually with the nuclear reticulum. The clear zone surrounding the vaccine body in sections of tissue is an artifact. The reticulum of the vaccine body takes the chromatin stain, indicating that it contains chromatin, and many of the bodies are so intimately connected with the nucleus, the meshes of one passing insensibly into the other, as to force the conclusion that these particular bodies have arisen by recent extrusion of nuclear chromatin into the cytoreticulum. Other bodies are disconnected from the nucleus and these may have arisen partly from the chromatin of the cytoplasm, a possibility which is furnished by Hertwig's theory of the constitution of cell protoplasm. Many of the vaccine bodies closely resemble the chromidial substance described by Hertwig in some lower animal cells. In the meshes of the reticulum the author has been unable to demonstrate any organized structure, but the meshes sometimes present nodal points of an underlying reticulum. In the fresh condition the meshes contain homogeneous refractive globules which disappear on drying.

Two series of changes may be followed in the vaccine bodies in Klatsch preparations. Many of them develop basic staining areas with loss of the central reticulum, and this process may continue until the entire body is transformed into a homogeneous globule resembling mucus or colloid. In others the reticulum breaks up into granules with or without the development of a central basic mass.

The author has been unable at any stage or in any derivative of the vaccine body to detect the slightest definite trace of a protozoon. Besides vaccine bodies there are other structures resembling protozoa to be seen in Klatsch preparations. They appear to be peculiar cell granules and are present in normal animals.

On the Tetanic Element in Bile: S. J. Meltzer and William Salant.

The authors have shown that the injection of bile can produce tetanus as well as coma. The latter is the more constant symptom. By the use of subminimum doses of strychnin a tetanic element could be shown to occur in bile that infallibly produced coma. A frog of medium size will not respond, even with the slightest hyperesthesia, to an injection of one hundredth of a milligram of strychnin. When such a small dose, however, is injected into a frog which had received a certain quantity of bile, the animal reacts, sooner or later, with a distinct tetanus. The effective dose of bile varies with the animal from which it is ob-

tained. The bile of rabbits produced, in many instances, distinctly convulsive effects even without the addition of strychnin.

The toxic effect on frogs of bile from normal rabbits varied considerably. The effect of the bile from some of the rabbits was predominantly coma, and from others tetanus. Heating the bile seemed to reduce the stupefying, paralyzing effect and to favor the appearance of the tetanic element. In the bile of nephrectomized rabbits the tetanic element was distinctly more pronounced than in the bile of normal animals.

A Preliminary Communication on the Pharmacology of Thorium: E. D. BROWN and TORALD SOLLMANN. (Presented by William J. Gies.)

Thorium nitrate precipitates proteids and is intensely astringent. Intravenous injection is promptly fatal by embolism. Applied subcutaneously, necrosis results. Introduced per os large doses have no appreciable effect. Solutions in sodium citrate are non-precipitant and non-astringent. Subcutaneous injection of large doses in citrate solution was without acute effect, although the animals appeared to be depressed and became emaciated, their tissues, after several weeks, showing widespread calcification. Absorbed thorium is excreted by the kidneys. The metal is neither absorbed nor excreted through the intestine.

A Preliminary Study of the Toxicological Action of Thorium: ARTHUR F. CHACE and WILLIAM J. GIES.

In addition to various results in harmony with those in the preceding report the authors presented the following data: In medium sized frogs at least 40 milligrams of thorium chlorid were required per os to produce the first sign of toxic symptoms, although 40 milligrams introduced subcutaneously or per rectum quickly manifested marked toxicity. Introduction per os caused irritation of the throat, increased gastric secretion, ejection of gastric contents and increased peristalsis. In fatal poisoning, by whatever channel of introduction, death was preceded by anhydrosis, twitching and progressive weakening of the muscles, with paralysis of the fore legs preceding that of the hind legs.

In warm-blooded animals large doses per os caused vomiting. In fatal cases, after introduction by other channels, death was preceded by restlessness, twitching and progressive paralysis of the muscles, labored breathing, stupor. Paralysis of the fore limbs resulted before loss of power in the hind ones.

The most constant and pronounced general effect in all the experiments was a progressive weakening of the voluntary muscles.

WILLIAM J. GIES,
Secretary.

THE GEOLOGICAL SOCIETY OF WASHINGTON.

THE 164th meeting was held on February 22, 1905. The regular program included a paper by T. W. Stanton, the discussion of which was participated in by Messrs. W. H. Dall, E. O. Ulrich, David White and H. S. Williams.

The Time Element in Stratigraphy and Correlation: Mr. T. W. STANTON.

Recently published discussions concerning recurrent and shifting faunas and transgressing formations have called renewed attention to the character of the facts on which geological correlation is based and have emphasized the doubts as to the possibility of determining that widely separated deposits were or were not contemporaneous. The argument briefly stated is as follows:

If a fauna or a flora appears suddenly in a certain bed of a local section the only reasonable inference is that it must have developed in some other area where its presence is recorded in older deposits. Similarly, if a fauna suddenly disappears from a section it is more probable that a change in local condition has caused it to shift to some favorable locality where it continued to live until its elements were modified, than that it actually ceased to exist. That such shiftings of faunas have taken place is proved by the observed recurrence of closely related faunas in several stages of some local section, while the intermediate stages show different faunas. Admitting that there has been much local differentiation and shifting of faunas in the past, similarity of fossil contents alone can

not be taken as proof of the exact contemporaneity of two beds, and dissimilarity of fossils within certain limits is not proof of difference in age.

When a littoral deposit is formed along the margin of a transgressing sea its base at one locality will not be synchronous with its base at another locality 100 miles farther inland. The difference in date will be measured by the time required for the sea to travel 100 miles across a subsiding area. In such cases physical continuity of a formation is not proof of exact contemporaneity.

The facts are not questioned and the importance of considering them in correlation and time determinations is obvious, but it is equally important to interpret them correctly and not to exaggerate their quantitative value. If undue importance is given to the theoretical errors in time determination and correlation caused by shifting faunas and transgressing formations, there is danger of overlooking the determinations that can actually be made or of exciting unnecessary doubts concerning them. These errors as a rule are geologically trivial and scarcely measurable in terms of the large units that must be used. The degree of accuracy that is required in human history is not to be expected in geologic history in which the time unit is so large and the scale so coarse that an interval of a few centuries is often not appreciable. The accuracy of geologic correlation, so far as the idea of contemporaneity is concerned, is commensurate only with the nature of the rough scale that must be used, and varies with the completeness and the character of the evidence in each special case. In general, the farther a correlation is carried the broader must be the terms in which it is expressed, but horizons vary greatly in this respect. At irregular intervals throughout the geologic column there are limited zones characterized by species or groups of species that have almost world-wide distribution. These zones, as Professor J. P. Smith has well stated, record times of readjustment of faunal provinces when for some reason interregional migrations were made easy. They may, therefore, be treated as geologically contemporaneous wherever they are found and they serve as the solid frame-work of the general chronologic structure.

Barriers, migrating faunas and shifting shores, make the local problems of correlation more difficult in special cases. With insufficient data or insufficient experience, or both, the geologist will make many mistakes, but when all the obtainable facts are fully studied from the broadest geological standpoint, when every element of the fauna and flora is given due weight, and when this is tested and supplemented by all other available classes of evidence, he can not only make correlations, but he can determine contemporaneity within the limits of accuracy that the subject demands.

Dr. Wm. H. Dall spoke on the evidences afforded by recent faunas, as bearing on the notion of contemporaneity in fossil horizons, drawing attention to the differences in number of species contained in a fauna relatively to its latitude, varying from 180 at Greenland, to 818 in the equatorial regions, a subject fully discussed in the U. S. Geological Survey Bulletin No. 84; to the total, or nearly total, differences between the faunas of rocky, sandy and muddy shores, due not only to the different lithologic situs, but to the differences of food-supply each afforded; to the fact that to define a fauna in the paleontologic or biologic sense, our definition must be wide enough to include all these purely local variations, and represent the whole population of a coast with all its variation of conditions; to the rapid spread of prepotent species given acceptable conditions, as in the case of *Mya arenaria*, introduced on the Pacific coast, and *Litorina litorea* on the Atlantic coast of the United States, both of which are known to have extended in profuse numbers over hundreds of miles of coast where they were previously unknown, in the course of a few years.

Dr. Dall also stated that the confusion of ideas with consequent controversies which have frequently occurred in connection with these questions, are largely due to the attempts on the part of geologists to combine in one expression two irrelevant factors, the 'formation,' considered as a lithologic unit, and the fauna as a time scale. A reference to the

existing coasts is all that is necessary to prove how absurd is the idea that the 'formation' of a given area has any necessary connection with the horizon or time-place in the geological column indicated by a given fauna. The two categories are, in a broad sense, incompatible, one indicating merely local physical and dynamic conditions, and the other the stage of evolution of the organic assembly inhabiting an area probably with entirely different boundaries.

Mr. E. O. Ulrich expressed his belief that the idea that faunas required a long time to migrate from place to place is an unjustifiable assumption. The migration of the Paleozoic faunas, which included mostly shallow water organisms, was limited to zones adjacent to the shore line. The Paleozoic continent had much less relief than the present surface and the adjacent water basins were shallow, thus favoring rapid migration. With slight relief a small amount of tilting would cause rapid submergence of large areas with immediate migration of marine life. Therefore, it would result that like fossil faunas indicate at least essential contemporaneity. The case cited as illustrating such geologic conditions with the rapid spread of a fauna was that afforded by the western and southern formations of the Richmond group in the uppermost Ordovician.

Mr. Ulrich stated that his working hypothesis is that one slowly modifying fauna existed continuously on the outer border of the continent while another occupied, on the whole, much shallower and frequently changing basins upon the surface of the continent. On account of the comparatively unstable conditions prevailing there the epicontinental fauna was subjected to many vicissitudes not shared by the outer fauna. Hence considerable and often very great modifications of its character, both local and widespread, took place much more frequently than in the outer fauna. When conditions were favorable, faunas of the inner basins were, in some cases, replenished, or in others, perhaps only slightly modified by accessions from the outer faunas.

Special emphasis was put by David White, the next speaker, on the relative insignificance of the time, as measured by sedimentation, required by those faunal migrations which are not marked by changes in the composition of the fauna and recognizable mutations of the species. The interval between the two great Pleistocene ice invasions was ample for the migration of the flora and even the formation of peats in the thin deposits of interglacial clays. Between the retreat of the last ice sheet and the restoration of the faunal and floral equilibrium, as we now find it, the interval, as measured in sediments, is geologically not macroscopic. The practical contemporaneity, in the geological sense, of an identical fauna in the various parts of its distributional province is shown by the general agreement and harmony in these parts between the marine invertebrates and the other contemporaneously characteristic classes of organisms, including marine vertebrates, land plants and land vertebrates, whose directions and routes of distribution varied widely. A plea was added for a closer study and a more scrutinous characterization of species, taking into account not only the contemporaneous variation of the organism, but also especially the variations or mutations occurring within the duration of the specific type, some of these mutations being of the most restricted vertical range, and consequently of greatest stratigraphic value.

GEORGE OTIS SMITH,
Secretary.

DISCUSSION AND CORRESPONDENCE.

THE WESTERN SIERRA MADRE MOUNTAINS.

TO THE EDITOR OF SCIENCE: The geographical and geological expedition organized by Col. W. C. Greene for the study of the western Sierra Madre Mountains of Mexico has accomplished half of the journey proposed. The party, consisting of Professor Robert T. Hill, Messrs. John Seward and F. H. Fayant and the writer, which left New York February 4, was delayed on its journey to El Paso by blizzards in Canada and the central states and exceptional cold weather in Texas. News of heavy snowfall in the mountains caused farther delay in El Paso, which was utilized by the party for a run across the arid region along the Mexican boundary as far as Naco, Arizona, and thence to Cananea, Soñora. The

route followed, that of the El Paso and Southwestern Railway, is particularly instructive as giving an excellent section of the mesa and the terraces bordering the Rio Grande. One is strongly impressed with the evidence of disintegration of rocks due to the great diurnal changes of the temperature, the work of wind and of sheet-flood erosion, the production of 'calichi' or local tufaceous limestone by capillary concentration of carbonate of lime, and other phenomena too numerous to mention. The railroad traverses several 'bolsens' or pocket deserts and the accompanying volcanic cones and basaltic flows. The Chiracahua Mountains of Arizona are the northern extension of the western Sierra Madres. The bolsens contain underground watercourses, and this important fact has led the Phelps-Dodge Company to establish the town of Douglas beside the Mexican boundary in a large bolsen lying east of their copper mines at Bisbee. Comparatively shallow wells supply abundant water for the great smelters of the Phelps-Dodge and Calumet-Arizona copper companies. The Phelps-Dodge Company gave our party the courtesy of a special train for the purpose of studying and photographing the phenomena of the mesa for thirty miles along the El Paso and Southwestern Railway.

On Tuesday, February 14, the party left El Paso and went southwestward into Chihuahua over the Rio Grande, Sierra Madre and Pacific Railway to the present terminus of the road at Nuevas Casas Grandes. Fifteen miles from El Paso the road reaches the top of the mesa, and from there onward excellent studies were made and photographs taken of the vast llanos, the peculiar moving sand hills known as 'los Medanos,' the lost mountains, and the remarkable shallow lagunas, or periodical lakes, without outlet, which receive the drainage from the Sierra Madre summits and form the final settling pans for the wind- and water-driven débris from the disintegrating mountains. From Lake Guzman, the largest of these lagunas, our route ascended the San Miguel River, first through wide basin-like valleys, then through deep, rugged, tortuous cañons, until finally its head waters were reached on the undulating plains of the great Sierra Madre plateau more than 7,000 feet above the sea, and 3,000 feet above the arid plateau containing Lake Guzman.

At Casas Grandes our party was shown the great prehistoric ruins which gave the town its name, by F. Mateus, the jéfe politico of the district, and at Colonia Juarez we were hospitably entertained by Mr. Ivins, the president of the prosperous colony of American Mormons located there. At San Diego we were guests at one of the great haciendas of Gen. Luis Terrazas, governor of the state of Chihuahua. For three days we traversed land belonging to the same proprietor and were brought into close realization of the tremendous influence of the hacienda, or estate owners, upon sociological conditions in Mexico. For 300 miles eastward to the Conchas River nearly every square mile of land is the property of Governor Terrazas, and he is probably one of the greatest individual landholders in the world.

From the terminus of the railway at Nuevas Casas Grandes southward the journey has been made on horseback and with pack train, and the route thus far covered aggregates 160 miles. Most valuable studies have been made of the remarkable igneous phenomena observed *en route;* a collection of the rocks has been made for the American Museum of Natural History, and photographs have been made illustrating every phase of the physiography, geology and vegetation of the region traversed.

After leaving the impressive cañon of the San Miguel our journey lay across the high plateau for about fifty miles to the new town of Dedrick, consisting of one habitable log house and several others in process of construction in the midst of the great forest of long-leafed yellow pine which characterizes the plateaus and peaks from 7,000 to 8,000 feet in elevation. Immediately west of Dedrick the plateau is scored by the great cañon, ten miles wide and nearly a mile deep, of the Yaqui River, here known as the Aros. This streamway is one of the most stupendous scenic features imaginable, and in beauty and grandeur rivals the famous Grand Cañon of the Colorado. Guaynopita is a little mining camp on the mountainside, four hundred feet

above the river and about thirty-five miles by trail west of Dedrick. The journey hither across and through the cañon has revealed a remarkable physiographic and geologic story which the party considers well worth the hardships of the journey and which will be made the subject of special papers. The region is full of archeological interest, too, through the ruins of cliff dwellers and other prehistoric peoples. In the Rio Chico branch of this cañon there is a set embracing thirty-seven houses.

From Guaynopita our course lies southward through the complex of cañons tributary to the great cañon of the Yaqui and out on to the plateau as far as Ocampo, where the famous ancient mine of Jesus Maria is located. Thence we turn back to Miñaca and there begin the long railway journey to New York.

EDMUND OTIS HOVEY.

THE METRIC SYSTEM AGAIN.

TO THE EDITOR OF SCIENCE: For the benefit of those who are clamoring for the adoption of the metric system, I desire to give an illustration of the beautiful simplicity of the system of units in vogue in the United States and Great Britain. Any of our units of measurement would answer the purpose, for they all partake of the same delightful elasticity of value. Let us take the collection of units of measure commonly denominated the gallon. In order that we may comprehend the relation of these various units to each other it is desirable to have some fixed unit as a means of comparison. As the cubic inch in use in America is not the same as that of Great Britain, and as it is desirable to use some unit of capacity that has only one value, we shall be compelled, much against our wishes, to use the liter as a unit in which to express the volume of the various members of the gallon family.

Gallon No. 1.—3.78543 liters. This gallon is variously denominated in the literature of metrology as the liquid (metric), liquid (national), metric (U. S.), Winchester, wine, and dry (metric). It is said to contain 231 American cubic inches. It is stated also that this gallon is generally used by American hydraulic engineers. It is a little difficult to be certain on this point, however, for many authors fail to state the volume of the gallon they use, in liters, and do not state whether American or British inches are meant.

Gallon No. 2.—4.4070 liters. This is the dry (national), or dry (U. S., or Br.), according to the Standard Dictionary. It is supposed to be used a good deal by tradesmen, and is sometimes referred to as a half peck. Whether it is used in England is a little difficult to ascertain, because of failure of writers to mention its volume in any fixed unit.

Gallon No. 3.—4.54346 liters. British (Mendenhall), liquid (U. S., or Br.), or Imperial gallon.

Gallon No. 4.—4.6209 liters. Legal standard dry gallon in Wisconsin and Connecticut; legal standard for ale, beer and milk in New Hampshire and Minnesota. Used in these states by tradesmen in *buying* these commodities. Also a legal standard in Maine.

Gallon No. 5.—'Proof' gallon. "This has the volume of a wine gallon containing one half its volume of nearly pure alcohol at 60° F." The number of proof gallons in a quantity of distilled liquor is found by multiplying the per cent. of proof (= twice the per cent. of alcohol present) by the number of wine gallons. Used by gaugers in assessing internal revenue tax on spirits.

I have not taken the time to verify all the references in parentheses above. Indeed, I was unable to do so with the ordinary reference books available to the student. It seemed, too, that in treating so simple and easily understood a subject, that it might be well to content myself with the above references, in order to show how simple the whole matter is, and what a delightful and satisfactory system we have, especially when exact measurements are needed. It is also probable that the careful reader will be stimulated by this hurried and incomplete account to investigate the subject further.

W. J. SPILLMAN.

NEW AMERICAN OSTRACODA.

TO THE EDITOR OF SCIENCE: In collections of ostracod crustaceans made near Greeley,

Colo., in the last four months, I find a number of specimens of *Ilyocypris bradyi* Sars. A collection made from a small stream in central Illinois in August last, consists entirely of a species of *Ilyocypris,* allied to *I. iners* Kaufmann, which appears to be undescribed.

The genus *Ilyocypris* Brady and Norman is widely distributed in Europe but has not hitherto been found in America. Including the two forms above mentioned, the family Cyprididæ is represented in North America by 44 recognizable species comprised in 12 genera. Of these, 2 genera, comprising 3 species, are exclusively American; the remaining 10 genera are represented by 13 species common to Europe and North America, and by 28 species which have been found only in North America.

A full description, with drawings, of the *Ilyocypris* from Illinois is in preparation.

Arthur E. Beardsley.

State Normal School, Greeley, Colorado,
March 17, 1905.

SPECIAL ARTICLES.

The Distribution of Fresh-Water Faunas as an Evidence of Drainage Modifications.*

As the result of careful studies of stream development, it has been well established by a number of investigators that very important changes in the arrangement of drainage lines are often produced by the capture of a portion of the waters of one stream by a tributary of some neighboring stream. It is but seldom that the actual process of immediate capture is witnessed. We most frequently see the evidence of conditions which we believe will ultimately lead to capture, or results which we believe have been produced by capture sometime in the past.

Whenever one stream succeeds in capturing a portion of the drainage system of one of its neighbors, there are certain results which must necessarily follow, just as there must have been certain conditions present to make the capture possible. By a study of the results produced it is often possible to learn what were the former relations of streams in a given region, and so prove the fact of capture, and even the approximate time of its occurrence. The evidences of drainage modifications, therefore, are of prime interest to the student of geography.

It is not my purpose to review the several results which are produced when one stream captures another, but rather to direct attention to one of the results produced, and to consider its value as an evidence that capture has occurred. At the outset it is necessary to divide the features produced by river capture into two distinct classes: (1) those features which are produced by river-capture and which can be produced by nothing else; (2) those features which are produced by river-capture, but which may also be produced by some other agency. Features belonging to the first class are of themselves definite proofs that river-capture has taken place. As an example of this type of evidence we may note the occurrence, along the former course of the stream which has suffered capture, of river-brought gravels which are so distributed that they could have reached their present position only through the agency of the captured stream. Features of the second class, however, when taken alone can not be regarded as proofs of river-capture, since, according to the basis of classification, they may also be produced by other agencies. Considered by themselves they are only of suggestive value; other lines of evidence must be appealed to before the river-capture, of which they may be the direct result, can be proved to have taken place. As an example of this type of evidence we may cite the continuation of a broad, open valley along the former course of a large, mature stream which has been diverted by capture. A similar valley may also be produced by a relatively insignificant stream, provided it is working on a band of soft, easily soluble rock, as has been the case along certain headwater branches of the James and Roanoke rivers. The existence of such a valley alone is, therefore, not conclusive evidence of capture, however strongly it may seem to suggest it.

It is well known that different streams are often marked by certain peculiarities of the

* Paper read before the Philadelphia Meeting of the Association of American Geographers.

faunas which inhabit them. The fresh-water shells of one drainage system may be distinctly different from the shells found in the neighboring drainage systems on either side—so much so, in fact, that the student of these forms can often tell at a glance from what locality a given museum specimen has come. Now it is evident that if river-capture takes place, the shells of the captured stream will mingle with those of the capturing stream. Such a commingling of faunas becomes an evidence of drainage modifications, and it is with this type of evidence that the present paper is concerned. It is important to know whether this evidence belongs to the first of the two classes above outlined, being a positive proof of river-capture; or whether it belongs to the second class, and is, therefore, only of suggestive value.

The line of evidence in question is not new. It has already been advanced in support of a great example of supposed river-capture. The Tennessee River after flowing southward through eastern Tennessee to a point near the present city of Chattanooga, leaves its broad, open valley and turns abruptly westward through a deep, narrow gorge in Walden Plateau. Dr. C. W. Hayes and Mr. M. R. Campbell, in a paper on 'The Geomorphology of the Southern Appalachians,' published in 1894, advocated the theory that the Tennessee formerly continued on southward viâ the Coosa and Alabama rivers into the Gulf of Mexico, but near the close of the Tertiary period was captured at the point near Chattanooga by a branch of a stream farther west. Six years later Mr. Chas. T. Simpson, studying the fresh-water shells of this region, came to the same conclusion; and in a paper on 'The Evidence of the Unionidæ Regarding the Former Courses of the Tennessee and Other Rivers,' published in SCIENCE in 1900, independently supported the theory of capture on the basis of the biological evidence alone.

This latter line of evidence was urged as absolute proof of the supposed river-capture, it being held that the shells must have direct water communication in order to pass from one stream to another. It is true that elsewhere the author has advocated other means of dispersal than river-capture, but these means were not considered in connection with the Tennessee problem. In this case the whole strength of the argument lay in the statement, 'these forms can not travel overland from river to river, but must have water communication in order to pass from one stream to another.' And since shells peculiarly like those of the Tennessee drainage were found mingled with the usual forms of the Coosa and Alabama rivers the conclusion was reached that the Tennessee must have been diverted from a former southward course by capture near Chattanooga. The paper has been widely accepted and quoted as an example of the definite proof of river-capture, and some who could not accept as conclusive the physiographic evidence presented by Messrs. Hayes and Campbell in support of the theory of capture were impelled to regard the biological evidence a final proof that the capture had taken place.

In connection with a study of the Tennessee problem I have been especially interested in the evidence furnished by the distribution of the fresh-water faunas, and have become convinced that the evidence should be included in the second of the two classes above outlined, being produced by river-capture in some cases, but also being produced by other agencies as well, and, therefore, not being conclusive in favor of capture. The reasons for this will best appear if we consider some concrete case, as that of the Tennessee, in which this line of evidence has been especially employed.

The facts brought forth by a study of the Unionidæ are as follows: *Pleurobema,* a genus of Unio, has its metropolis in the Tennessee River. It is not found throughout the other portions of the Mississippi basin. But it is found abundantly in the Coosa and Alabama rivers. Also certain other forms of Unio common to the Mississippi-Tennessee basin are found in the Coosá-Alabama basin. From these facts it was concluded that at some time the upper Tennessee River must have flowed southward into the Coosa-Alabama River. On the basis of this line of argument we must necessarily assume that the fresh-water mus-

sels require direct fresh-water communication in order to pass from one stream to another. It appears that the recorded observations of many naturalists and the facts of Unionidæ distribution are both contrary to this conception. In the first place, there are so many authentic cases where birds, insects, etc., have been taken with fresh-water shells attached to them, that students of the subject are compelled to accept this method of dispersion of these forms from place to place. Darwin proved that young molluscs just hatching will attach themselves to the feet of a duck, and remain alive in this position out of water from twelve to twenty hours. Mr. Arthur F. Gray, of Danversport, Massachusetts, had in his possession the foot of a water fowl to which was attached a bivalve shell. Canon Tristran shot a bird in the Sahara which had attached to it the eggs of some mollusc. Some shells attach themselves to plants which are carried away by birds (Darwin). Insects are frequently taken with shells attached. There are at least five recorded cases of the capture of the water-scorpion, *Nepa*, a large flying bug, with small shells attached. The great water-beetle, *Dytiscus*, is known similarly to aid in the dispersion of fresh-water mollusca. The same is true of *Dineutes*. Mr. Albert P. Morse, of Wellesley, has kindly shown me specimens of these last two forms having attached shells. *Notonecta* has likewise been proved to carry these forms from place to place. Some of these insects are powerful fliers. Darwin records the capture of one of them out at sea, forty-five miles from the nearest land. Beddard, Kew and other students of zoogeography regard birds and insects as undoubtedly important agents in the dispersion of fresh-water shells. Woodworth catalogues a number of agencies recorded as aiding in this dispersion, in addition to those mentioned above. It appears, then, that other means besides river-capture for the passing of fresh-water shells from one stream to another are not lacking. That these means are efficient is proved by the distribution of these shells. Ponds are sometimes made by excavating a place where no water stands ordinarily, lining the excavation with concrete and allowing the rain to fill it. These ponds, for a time devoid of life, gradually become populated with molluscs and other shells, proving, as Beddard says, the capacity for active or passive migration on the part of the Mollusca. Careful and successive observations have proved in some instances the actual time in which a given pond may become populated. R. Ellsworth Call records the presence of a western species of Unio in a small isolated eastern lake, which was located down between high hills, fed by a mountain brook, and absolutely foreign to any stream through which the species might have been introduced.

But the most conclusive objection to accepting this evidence as a proof of river-capture is found in the actual distribution of the very shells upon which the argument is based. The genus *Pleurobema* is found in both the Tennessee and Coosa-Alabama basins. In no case are the species in the two basins identical, but only similar. The basis of the argument, then, is similarity of forms. But if mere similarity of forms proves former river connection, certainly identity of form should prove it with double force. Accordingly we should not expect to find the same species of *Pleurobema* in any two rivers of this section whose location is such as to render practically impossible a former connection with each other. An examination of Mr. Simpson's important monograph on the pearly fresh-water mussels shows that *Pleurobema similans* Lea, is found in Black Warrior and Cahawba rivers, Alabama, and Pine Barren Creek, Escambia County, Florida. So far as can be judged from available maps, previous fresh-water communication between the former and the latter is extremely improbable. *Pleurobema strodeana* Wright, is recorded from Escambia River, Florida, and Flint River, Georgia. Any former connection in this case seems impossible. *Pleurobema harperi* Wright, is recorded from Altamaha and Flint rivers, Georgia, and Suwanee River, Florida. Here, again, connection between either of the former and the latter seems out of the question. Other cases might be added—indefinitely, if we continue with other genera than

Pleurobema. If we find it impossible to hold river-capture responsible for the distribution of identical species in all these cases, then mere similarity of forms in the Tennessee and Coosa-Alabama basins can not be regarded as proof of river-capture near Chattanooga.

If we carry this line of argument to its logical conclusion, the objections to it become even more apparent. One group of Unios is recorded as occurring everywhere in the streams draining into the Atlantic from Labrador to Georgia. If the occurrence of the *Pleurobema* in the Tennessee and Coosa-Alabama rivers proves river-capture in that case, then the distribution just referred to must prove a great succession of river-captures from Labrador to Georgia. The same species is, in one instance, found in Europe, northern Asia, Japan, northern North America and Iceland. According to the argument advanced this means world-wide land connections and an inconceivable series of river-captures. Such violent hypotheses compel the conclusion that some other means than river-capture is most commonly operative in effecting the distribution of fresh-water shells.

It is believed that all the phenomena noted are easily explicable independently of the theory of capture, and, in this connection, it is well to note that the presence of a longitudinal, open valley across the low divide between the two basins is peculiarly favorable for the operation of some of the means of dispersal referred to above. The northward and southward migrations of birds along certain valleys is known, and where a low divide in a prominent valley alone separates the waters of two river systems it is to be expected that more or less mingling of forms will very likely take place.

In our consideration of this line of evidence it is of interest to recall Mr. Simpson's statements regarding the dispersal of these shells, which appear in his paper on the 'Distribution of North American Unionidæ,'* published seven years prior to his Tennessee paper. In a footnote (p. 354) he observes: "In many cases the Unionidæ seem to have had no difficulty in migrating across the country from river to river; an example of this being the Mississippi Valley species which inhabit all the rivers of Texas, and some of those of eastern Mexico; while on the other hand, species of South America extend up into Central America. The embryos, in some cases, may be carried by aquatic birds in the manner elsewhere mentioned in this paper; in others, they probably migrate across overflowed regions near the sea, in time of floods." Further on (p. 358), in accounting for the presence of *Unio luteolus* in both the Missouri and Columbia rivers, Mr. Simpson says: "I have traced it up the Missouri River to near its source, and when it is taken into consideration that the Marias, a tributary of this stream, heads within a few miles of Flathead Lake on Clarke's River, a branch of the Columbia, and that the embryos of Unios are provided with hooks by which they can attach themselves to the feet or feathers of aquatic birds, it is very easy to see how this species might have been carried from the waters of one drainage system to those of another."

It is believed, then, that the well-authenticated means of dispersal of mollusca, and more especially the facts of molluscan distribution, are such as to render it impossible to regard the distribution of fresh-water faunas as a conclusive evidence of drainage modifications. We must place this line of evidence in the second of the two classes outlined above—it being the result of river-capture in some cases, but being also produced as a result of other agencies. Whether the Tennessee River has suffered capture or not is a question which can not be settled on the basis of this class of evidence. Other sources must be appealed to. And while the Tennessee problem is a question in itself, it may not be amiss, especially in view of the wide attention attracted by the application of this line of evidence to that problem, to say that I have elsewhere pointed out certain objections to the theory of recent capture, and called attention to a variety of evidence now available

* 'On the Relationships and Distribution of the North American Unionidæ, with Notes on the West Coast Species,' *American Naturalist*, XXVII., 353–358, 1893.

which seems to indicate that the Tennessee has persisted in its present course for a long period of time.*

If the distribution of fresh-water faunas can not be regarded as a proof of river-capture, it is pertinent to ask, of what value is this class of evidence?

It seems to me that this will largely depend upon local conditions which must be taken into account in each individual problem. If there is a marked similarity or identity of forms in the captured stream and the stream representing the supposed former, lower course, and no such relation is found in any other two streams of the region, the evidence would be very suggestive. If the special forms thus distributed are so constructed anatomically as to be poorly adapted to dispersion by birds, insects, etc., the evidence would become much stronger. But if the divide between the two basins is low and indistinct and occurs in a broad, open valley along which aquatic birds are known to migrate habitually, and the shells in question are adapted to the various means of dispersal, then the opportunities for transference of forms between the two basins would be so excellent that the faunal evidence would be worthless as a proof of river capture. On the other hand, where no commingling of forms occurs, it might appear that no recent capture could have taken place and the evidence thus become of negative value. But even here we must take into consideration the restricted distribution of some forms along the same stream, due to the character of shores and stream bed, the intervention of falls or rapids and other features. Even where capture has taken place, the forms may not be transferred to the lower, new course of the stream, since they may not be found in the lower courses of streams long established in their present relations.

In conclusion, it is believed that the dispersion of fresh-water faunas is effected by so many different agencies, and the features of distribution are dependent on so many different factors, that such distribution can have but very limited value as an evidence of drainage modifications. In the cases where this evidence has already been offered as a proof of river-capture, it is believed that the conditions are such as to render its use invalid. It seems necessary to subject such evidence to unusually critical examination before *offering* it in support of any theory of drainage modifications, or *accepting* it as proof of the correctness of any such theory.

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* The full discussion of the Tennessee problem will appear in a forthcoming issue of the *Journal of Geology*.

CURRENT NOTES ON METEOROLOGY.

LONG-RANGE WEATHER FORECASTS.

The Weather Bureau has wisely published a *Bulletin* (No. 35) on the subject of 'Long-Range Weather Forecasts,' prepared by Professor E. B. Garriott, in order to counteract, so far as is possible, the misleading predictions for a month or a season in advance which are constantly finding their way into our newspapers. Indeed, such spurious long-range predictions are actually sold to the papers and to the public, and are most injurious in their effects. Long-range predictions are of various kinds, ranging from those based upon supposed planetary influences to such well-known statements, found in farmers' almanacs, as 'About—this—time—expect—showers,' these five words being so printed that they apply to a week or ten days of time. There are also other classes, based upon a careful study of sunspot periods, lunar periods, etc., some of which, as in the case of the recent investigations of Sir Norman Lockyer and Dr. W. J. S. Lockyer, seem to promise something in the way of more definite results. As to lunar influences, although much time has been spent on this matter, and faint lunar tides in the atmosphere have been made out near the equator, in the present state of our knowledge, as Angot put it two or three years ago, 'it can not be affirmed that the moon does exert any influence upon the weather, but at the same time it should not be denied that this influence may possibly exist.' As to seasonal predictions based upon the behavior and condition of animals, it is clear that the physical

condition of the animal depends upon past weather conditions, and upon the food supply which those conditions have furnished, rather than upon future weather. The best that can be done at the present time is to make forecasts for one or two days in advance, and occasionally for three or four days. The future advance will depend upon a closer study of atmospheric pressure conditions over large areas, and of the influences which bring about normal or abnormal distribution of pressure.

THE LOW RELATIVE HUMIDITY OF WINNIPEG IN WINTER.

IN a recent number of *Nature* (March 9, 1905) reference is made to some interesting electrical and other effects of the dry air of Winnipeg in winter, as reported by Professor Buller, of the University of Manitoba. The common experiment designed to show the presence of water vapor in the atmosphere, which is performed by exposing calcium chloride, has to be done in a damp-chamber. The substance shows no apparent signs of deliquescence even after some weeks' exposure to the ordinary air.

JELINEK'S METEOROLOGICAL INSTRUCTIONS.

A FIFTH edition of Jelinek's valuable 'Anleitung zu meteorologischen Beobachtungen' has been issued, under the direction of Dr. J. M. Pernter, the director of the Austrian Meteorological Institute. The fourth edition was dated 1903, and that, together with the third (1884), was revised by Dr. Hann. There are many admirable handbooks of instructions for meteorological observers, but this one has always stood in the front rank, and in its new edition, with many illustrations, is thoroughly up to date in every particular.

HANN'S LEHRBUCH DER METEOROLOGIE.

A NEW edition of Hann's invaluable 'Lehrbuch der Meteorologie' is on the way, the first part being already issued. There is no need of pointing out that the new edition will be thoroughly up to date, and that no teacher or student of meteorology can afford to do without it. It will consist of about six parts. Not the least of the many important additions will be the extension of the charts so as to include the recent important Antarctic discoveries.

A NEW RAIN GAUGE.

THE *Meteorologische Zeitschrift* for January, 1905, contains a description of a new form of rain gauge designed by W. Gallenkampf, of Munich. The unsatisfactory character of the record made by the ordinary self-recording gauge, which does not show the details of rainfall sufficiently well, has led to the construction of a gauge from which the rainfall *drops*. Each drop falls on one end of a delicately-balanced arm, which descends under the weight, closes a circuit, and thus the fall of one drop is recorded. So detailed is the record that the rainfall curve can be plotted on the basis of the number of drops which fall from the gauge in half a minute, and these curves show clearly that the ordinary shower is very variable in its intensity, these smaller variations not being shown on the usual rain-gauge record. A number of curves illustrate the article, and throw a new light on the way in which our rain falls.

THE MICRO-BAROGRAPH.

IN the *Quarterly Journal of the Royal Meteorological Society*, Vol. XXXI., 1905, pp. 39–52, Dr. W. N. Shaw and Mr. W. H. Dines describe an apparatus called the 'Micro-Barograph,' which has been designed to magnify the minor fluctuations and at the same time to disentangle them from the general barometric surges. The causes which suggest themselves as likely to produce temporary fluctuations of the barometric curves are the following: (1) Atmospheric billows passing along surfaces where there is discontinuity in density, in a manner similar to ocean waves; (2) the passage of minute whirls, or cyclonic depressions of small dimensions; (3) variations of pressure due to the attraction or repulsion produced by electric stress as masses of air at different potential pass by; (4) the mechanical effects of wind, and (5) the mechanical effects of the rapid condensation of aqueous vapor.

NOTES.

THE effect of a severe drought upon meteorological observations is seen in the 'Report'

of the Meteorological Commission of Cape Colony for 1903. There is a fair increase in the number of ordinary stations over 1902, but the rainfall stations show a decrease of 31. This is due to the fact that, owing to a drought, many farmers have 'trekked' with their cattle to adjoining territories, leaving their homesteads unoccupied.

Mr. D. E. Hutchins, of Cape Town, discusses the relation of the rainfalls of South Africa and of India during the period 1892–1902, and finds that the years of famine in India have been followed by years of bad drought in South Africa. The belief is expressed that the summer rains of South Africa have their origin in the moist winds from the Indian Ocean (*Nature*, Vol. 71, 1905, 342–344).

R. DeC. Ward.

A CONTEMPLATED MAGNETIC SURVEY OF THE NORTH PACIFIC OCEAN BY THE CARNEGIE INSTITUTION.

A project for a magnetic survey of the North Pacific Ocean by the Department of International Research in Terrestrial Magnetism has been favorably acted upon by the executive committee of the Carnegie Institution of Washington, and authorization has been given to begin the work this year. An initial allotment of $20,000 has been made to cover the expenses for the current year.

As is well known, the state of our knowledge of the distribution of the magnetic forces over the greater portion of the earth—the oceanic areas—owing to the paucity of precise data, is exceedingly unsatisfactory. This fact is especially true for that great body of water—the Pacific Ocean—rapidly developing in great commercial importance.

Captain Creak, for many years superintendent of the Compass Department of the British Admiralty, now retired, says: 'The North Pacific Ocean is, with the exception of the voyage of the *Challenger*, nearly a blank as regards magnetic observations, and I, therefore, think the magnetic survey proposed will be of great value.'

Hence, except for data from occasional expeditions and such as were acquired in wooden vessels a long time ago, the present magnetic charts used by the navigator over this region depend largely upon the observations on islands and along the coasts. Such land observations, however, are rarely representative of the true values because of prevalent local disturbances. It is, therefore, impossible to make any statement as to the correctness of the present charts. The demands of science, as well as those of commerce and navigation, require a systematic magnetic survey of this region under the most favorable conditions possible and that the work be done under the auspices of some recognized research institution in order to insure that the scientific aspects of the work receive their adequate recognition.

The eminent physicist and magnetician, Professor Arthur Schuster, states as his opinion: "I believe that no material progress of terrestrial magnetism is possible until the magnetic constants of the great ocean basins, especially the Pacific, have been determined more accurately than they are present. There is reason to believe that these constants may be affected by considerable systematic errors. It is possible that these errors have crept in by paying too much attention to measurements made on islands and along the sea-coast. What is wanted is more numerous and more accurate observations on the sea itself." Furthermore, the superintendent of the United States Coast and Geodetic Survey, Mr. O. H. Tittmann, says: "There is no doubt in my mind that a survey for that purpose would result in obtaining data of great and permanent value and that it should be undertaken."

Additional quotations could be given; the above, however, are representative and show sufficiently the great importance of the proposed work and the fruitful results that may confidently be expected. It is the hope that upon the completion of the magnetic survey of the North Pacific, the means will be forthcoming for extending the survey so as to include other oceanic areas. An effort will, furthermore, be made to secure the interest and cooperation of all civilized countries, so that we may look forward to the completion of a general magnetic survey of the accessible portions of the globe within about fifteen

years. Thanks to the awakening and renewed interest in magnetic work shown on all sides, I fully believe that this hope will be realized.

The matter of prime consideration in magnetic work at sea is the elimination of the effects resulting from the ship's own magnetism as due to her construction and equipment. Such effects are especially troublesome to eliminate when it is proposed to obtain not only the magnetic declination at sea, but also the other magnetic elements (the dip and the intensity of the magnetic force). The plan, therefore, to be attempted this year, as worked out by Mr. G. W. Littlehales, hydrographic engineer of the United States Hydrographic Office and consulting hydrographer of the Department of Terrestrial Magnetism of the Carnegie Institution, is in brief as follows: "To charter a wood-built, non-magnetic, sailing vessel of about six hundred tons displacement, which, starting out in summer from San Francisco, shall pursue a clockwise spiral course embracing the entire North Pacific Ocean. The object of planning such a course is to gain continuous advantage throughout the survey of the dynamical agencies of the atmosphere and the ocean, in passing in succession into each of the five-degree quadrangles into which the chart* is divided and in which observed values of the three magnetic elements need to be obtained.

"The seasonal shifting of the permanent centers of barometric pressure will cause a variation from month to month of the conditions of wind and current that are represented on this particular chart, but if the departure from San Francisco be taken in the summer, the chain of meteorological events will contribute toward the maximum progress over the course, passing thence along the west coast of America to the vicinity of the Galapagos Islands, thence across the Pacific in latitude between two and three degrees north, thence along the eastern side of the Philippine Archipelago and the empire of Japan, thence eastward in about latitude fifty-two degrees north, thence to the latitude of San Francisco, and thence continuing through the series of areas bounded by parallels of latitude and meridians of longitude each five degrees apart, lying next on the midocean side of the circuit last made, and proceeding gradually and by successive circuits into the central region of the North Pacific."

The total length of the course marked out is about 70,000 knots; however, each of the first circuits practically closes at San Francisco, so that, if it is found that the method pursued is not the best, the work can readily be terminated or modified. From inquiries made, it would appear that the entire work of observation and reduction can be accomplished in three years. The cost per month of the field work, inclusive of all expenses and services, will approximate $1,500. Counting eight months of continuous service per annum, the total annual outlay is estimated at about $12,000.

This project as the result of careful consideration and solicitation of expert opinion is believed to be thoroughly feasible. It permits of useful comprehensive results being immediately obtained, and is one which can be interrupted without any important waste of antecedent expense, whenever circumstances may render a discontinuance or a modification of the original plan advisable.

The region it is proposed at present to survey fortunately contains magnetic observatories in requisite number and proper distribution for furnishing the necessary corrections to be applied to the observed magnetic elements in order to reduce them to a common epoch. Thus continuous records of the magnetic variations required for this purpose will be available from the following stations: Sitka, Mexico, Honolulu, Manila, Shanghai, Tokio. In addition it is hoped that there may be soon a magnetic observatory in California or vicinity for lending effective cooperation, and that the German government will continue its magnetic observatory at Apia throughout the period of the survey. Also excellent opportunities for controlling instrumental constants and obtaining required additional data will be afforded by stations on the coasts and on islands.

* The course to be followed was shown in red ink on a U. S. Hydrographic Office Pilot Chart of the North Pacific.

It should also be pointed out that the plan of the courses as mapped permits ready adjustment of the observed quantities for closed areas, in accordance with the potential hypothesis, and it may permit to a certain degree the testing of the accuracy of this assumption, though as regards the latter more can be said at the end of a year's work.

While it is not anticipated that any marked irregularities in the distribution of the earth's magnetism will manifest themselves over the deep waters of the Pacific, it may confidently be expected that in the neighborhood of the islands and along the coasts distortions and irregularities will be revealed. With the aid of the results of the detailed magnetic survey of the United States and Alaska, opportunity will, therefore, be afforded of studying the effect of the configuration of land and water upon the distribution of the magnetic forces. The first circuit, passing as it does along the American and Asiatic coasts, will yield especially interesting results in this respect. Thus, for example, along the Aleutian Islands marked local disturbances will be disclosed. Reports are received frequently from mariners in this region regarding the unsatisfactory behavior of the compass; it is, therefore, greatly to be desired that a systematic magnetic survey of the waters in this region be made.

Additional information regarding the expedition will be given later.

L. A. Bauer,
Director.

Department of Terrestrial Magnetism,
Carnegie Institution,
Washington, D. C.

THE ELIZABETH THOMPSON SCIENCE FUND.

The thirtieth meeting of the board of trustees was held at the Harvard Medical School, Boston, Mass., on March 17. The following officers were elected:

President—Henry P. Bowditch.
Treasurer—Carles S. Rackemann.
Secretary—Charles S. Minot.

The report of the treasurer, showing a balance of income on hand of $1,237.79, was accepted and placed on file. The secretary reported that the following grant had been made:

No. 116, $150, to W. Bateson, Esq., for experiments on heredity in rabbits, to be conducted under Mr. Bateson's direction by Mr. C. C. Hurst.

Reports of progress were received from the following recipients of grants:

No. 27. E. Hartwig.
No. 60. F. Kruger.
No. 94. A. M. Reese.
No. 96. H. E. Crampton.
No. 98. J. Weinzirl.
No. 101. T. A. Jaggar, Jr.
No. 103. E. Anding.
No. 106. W. Valentiner.
No. 107. M. W. Travers.
No. 108. B. L. Seawell.
No. 109. A. Nicolas.
No. 110. H. S. Grindley.
No. 111. R. Hürthle.
No. 112. W. J. Moenkhaus.
No. 113. S. P. Fergusson.
No. 114. W. Rosenthal.
No. 115. H. S. Carhart.
No. 116. W. Bateson.

The work having been completed and published, it was voted to close the records for the following grants:

No. 71. A. Nicolas.
No. 79. H. S. Grindley.
No. 100. H. H. Field.
No. 102. E. O. Jordan.
No. 104. W. P. Bradley.

It was further voted that the work having been completed, the records of the following grants should be closed, when copies of the published results were received by the trustees:

No. 65. O. Lubarsch.
No. 73. J. von Kennell.
No. 83. W. L. Tower.

Mr. F. W. Bancroft, who held grant No. 97, reported that his experiments had been made for the transplantation of ovaries in rabbits, but that he had not succeeded in obtaining ova from such transplanted ovaries. It was deemed, therefore, inadvisable to continue the research, and it was voted to close the record of his grant, and to allow him to use the material which he had on hand for other researches.

The secretary reported that thirty-one applications for grants had been received, the total amount asked for being nearly $9,000. After a thorough discussion and extended deliberation, the board found itself obliged to refuse a number of applications of high merit to which it would have been very glad to extend aid, had the resources of the fund permitted. It was voted to make the following new grants:

No. 117, $100 to Professor E. Salkowski and Dr. C. Neuberg, Berlin, Germany, for an experimental study of glycuronic acid. (Application 966.)

No. 118, $200 to Professor Th. Boveri, Würzburg, Germany, for an experimental study of the early development of sea urchin eggs. (Application 981.)

No. 119, $100 to Professor J. P. McMurrich, Ann Arbor, Mich., for the study of Actinians from the Malayan Archipelago. (Application 984.)

No. 120, $50 to Professor E. H. Archibald, Syracuse, N. Y., for researches on the electrical conductivity of solutions of organic bodies in the liquefied halogen hydrides. (Application 987.)

No. 121, $200 to Professor A. Debierne, Paris, France, for the isolation and study of Actinium. (Application 988.)

No. 122, $200 to Dr. Fr. Nušl and J. J. Frič, Prague, Austria, for perfecting an instrument for the determination of latitude and time without the use of levels. (Application 991.)

No. 123, $200 to Professor E. C. Jeffrey, Cambridge, Mass., for the study of cupressineous conifers. (Application 998.)

No. 124, $150 to Professor P. Bachmetjew, Sofia, Bulgaria, for the study of the anabiotic condition in warm-blooded animals. (Application 999.)

CHARLES S. MINOT,
Secretary.

MEDALS AND AWARDS OF THE ROYAL GEOGRAPHICAL SOCIETY.

THE London *Times* states that with the approval of the king, the council of the Royal Geographical Society has decided to award the two royal medals for this year to Sir Martin Conway (Founder's Medal) and Captain C. H. D. Ryder, R.E. (Patron's Medal).

During a long series of years Sir Martin Conway has devoted himself to the exploration of various mountain regions of the world—the Alps, the Himalayas and the Andes; and, further, has done useful work among the islands of Spitsbergen. In a series of papers and maps contributed to the society, as well as in separate publications, he has made, as a result of these explorations, large and valuable contributions to geographical knowledge.

Captain Ryder's claim to a Royal Medal rests mainly on the important and extensive work which he accomplished while acting as principal survey officer on the recent Tibet Mission. Not only did he execute a large amount of survey work and mapping while on the main expedition, but as survey officer in the expedition into Western Tibet he surveyed and mapped the Upper Brahmaputra to its source, as well as the Sutlej and the Gartok tributary of the Indus. He also surveyed the whole of the line of mountains lying north of the Himalayas, and proved that there is no peak that can approach Mount Everest in altitude. Before these experiences Captain Ryder, in 1899–1900, carried out a careful survey of the province of Yunnan, the results of which, comprising a map radically altering those previously compiled, he contributed to the society.

This year an award is again made of the Victoria Research Medal, which was instituted on the death of Queen Victoria, and is bestowed as occasion may arise in recognition of distinguished service to the cause of geographical research, as distinguished from exploration. The new recipient—the third to receive the medal—will be Mr. J. G. Bartholomew. During many years Mr. Bartholomew has done much to raise the standard of cartography in Great Britain. He has edited and issued large atlases of England and Scotland; he has planned and issued the first volume of a great physical atlas which will take the first place among works of its kind; he has for years been collecting material for a com-

plete atlas of the British Empire. All this has been achieved at his own expense, and has entailed the expenditure of thousands of pounds, which he can never hope to recover.

Of the society's minor awards, the Murchison Grant goes to Mr. William Wallace, C.M.G., Deputy High Commissioner of the Northern Nigeria Protectorate. During the many years he has served as an official in Northern Nigeria, Mr. Wallace has rendered great service to exploration and geography, both directly and indirectly. Colonel F. R. Maunsell, R.A., is awarded the Gill Memorial for his explorations during many years' residence in Asia Minor, and in particular for the large map which he has compiled, largely from his own materials, and placed at the disposal of the society. The recipient of the Cuthbert Peek Grant is Mr. Francis J. Lewis, who has made valuable contributions to the knowledge of botanical distribution by his researches into the geographical distribution of vegetation in the North of England. Finally, Captain Philip Maud, R.E., is designated to receive the Back Grant for valuable survey work in 1903 along the southern border of Abyssinia.

PROFESSOR WILHELM OSTWALD AT HARVARD UNIVERSITY.

Harvard University has invited Professor Wilhelm Ostwald, of the University of Leipzig, to serve as lecturer in the first half of the coming academic year, under the arrangement for an exchange of professors which has recently been agreed upon by Harvard University and the German Government. Professor Ostwald is regarded as one of the founders of the modern science of physical chemistry; and he has achieved a position of the highest rank in the scientific world, not only as an investigator and thinker, but also as a reformer, organizer and teacher in the field of natural science. With J. H. van't Hoff, Ostwald founded in 1887 the *Zeitschrift für physikalische Chemie*, and in 1901 the *Annalen der Naturphilosophie*. In 1904 he gave the Faraday lecture before the Royal Society. He has been a prolific and indefatigable investigator and writer, and a list of his publications would occupy several closely printed pages. Although he achieved eminence first in the field of physical chemistry, Professor Ostwald has during the last four or five years diverted, or perhaps rather extended, his studies to the broad field of the philosophy of science, a subject to which one of his best-known works, as well as the *Annalen* above mentioned, is devoted.

Professor Ostwald has not yet definitely announced the subjects of the courses which he will give during his residence at Harvard. It is hoped, however, that he will give one course counting for a degree on the history of science, a course which would be of interest to students in all branches of science as well as to students of philosophy. It is also hoped that he will announce one or two courses in his special field of physical chemistry, thus affording a rare opportunty to graduate students in chemistry who may be in residence next year.

Friedrich Wilhelm Ostwald was born in the city of Riga in Russia September 2, 1853. He attended the Kronsknabenschule and the Realgymnasium of Riga, showing as a schoolboy a remarkable talent for writing and drawing, which he put into use as editor of a schoolboy magazine. In 1872, against the wish of his father, who thought to make an engineer of him, he entered the University of Dorpat in Russia to pursue the study of chemistry. In 1875 he became an assistant in physics to von Oettingen. He took the master's examination at Dorpat in 1877 and the doctorate in 1878. In 1879 he began his teaching career as a privatdocent, and in the same year exchanged his assistantship in physics for one in chemistry under Carl Schmidt. In 1881 he was called to a professorship of chemistry at the Polytechnikum in his native city, and held this place until 1887, when he accepted an appointment as professor of physical chemistry at Leipzig—the position which he still holds. Professor Ostwald was one of the delegates to the International Congress of Arts and Science at St. Louis last year.

A CONFERENCE OF ANATOMISTS.

Invitations have been issued by the Wistar Institute of Anatomy, Philadelphia, to ten of

the leading anatomists of the United States to participate in a conference in the interests of anatomy in America. Two sessions of this conference were to be held in the library of the Wistar Institute, on April 11 and 12, beginning each day at 10:30 A.M. The object of this conference is to discuss the possibility, advisability and means of organizing central institutes for the promotion of research in the different subdivisions of anatomy such as physical anthropology, comparative anatomy, topographical anatomy, embryology, histology and neurology, and to establish relationship with similar institutes abroad. The conference was proposed by Dr. M. J. Greenman, director of the Wistar Institute, and the following anatomists are expected to be present: Dr. Lewellys F. Barker, professor of anatomy, Chicago University; Dr. Edwin G. Conklin, professor of zoology, University of Pennsylvania; Dr. Henry H. Donaldson, professor of neurology, University of Chicago; Mr. Simon H. Gage, professor of embryology, Cornell University; Dr. G. Carl Huber, professor of embryology, University of Michigan; Dr. Geo. S. Huntington, professor of anatomy, Columbia University; Dr. Franklin P. Mall, professor of anatomy, Johns Hopkins University; Dr. J. P. McMurrich, professor of anatomy, University of Michigan; Dr. Chas. S. Minot, professor of embryology, Harvard University; Dr. George A. Piersol, professor of anatomy, University of Pennsylvania.

SCIENTIFIC NOTES AND NEWS.

THE National Academy of Sciences will hold its annual stated session at Washington, beginning Tuesday, April 18.

THE American Philosophical Society is this week holding its general meeting at Philadelphia.

DR. R. S. WOODWARD, president of the Carnegie Institution, was given a dinner by his colleagues at Columbia University, at Delmonico's, on April 4. Speeches were made by President Butler, Mr. Andrew Carnegie, Dr. John S. Billings, Professor E. B. Wilson and President Woodward.

DR. H. A. LORENTZ, professor of physics in the University of Leyden, and Professor V. F. Bjerknes, professor of mathematical physics in the University of Stockholm, will give courses of lectures at Columbia University next year.

PROFESSOR HENRY S. CARHART, who holds the chair of physics at the University of Michigan, and Professor W. B. Scott, who holds the chair of geology at Princeton, have been invited to join the official party to attend the South African meeting of the British Association for the Advancement of Science this summer.

PROFESSOR R. W. WOOD, of the department of physics of the Johns Hopkins University, and Dr. H. S. Jennings, of the zoological department of the University of Pennsylvania, have been elected honorary fellows of the Royal Microscopical Society of Great Britain.

PROFESSOR HUGO DE VRIES, professor of botany at Amsterdam, has been made a foreign member of the Belgian Academy of Sciences.

PROFESSOR E. VON DRYGALSKI has been elected a foreign member of the Geographical Society of Vienna.

THE Fothergillian prize of the Medical Society of London for 1905 has been awarded, by the council of the society, to Sir Frederick Treves in recognition of the value of his work in connection with abdominal surgery.

PROFESSOR WILLIAM H. PICKERING, of the Harvard College Observatory, will observe the total eclipse of the sun on August 30, in Algeria.

PROFESSOR ALBERT M. REESE, of Syracuse University, will go to Florida at the end of May under the auspices of the Smithsonian Institution to collect eggs of the alligator with which to work out its embryology; subsequently he will spend some time at the biological laboratory of the Carnegie Institution on the Dry Tortugas.

DR. MARCUS S. FARR, curator in the Department of Paleontology, Princeton University, will again this year conduct an expedition to Wyoming and Montana.

AT the meeting of the Physicochemical Club of Boston and Cambridge, at Harvard Union, on March 27, Professor A. A. Noyes spoke on the conductivity of certain acids, bases and

salts up to 218°, and Professor T. W. Richards spoke on the elimination of thermometric lag and the cooling correction in accurate calorimetry.

On the anniversary of the death of Dr. Charles E. Beecher, who held the chair of paleontology at Yale University, his portrait was hung in the registrar's office.

Professor Albert A. Wright, since 1874 professor of geology and zoology at Oberlin College, died at Oberlin as the result of a stroke of paralysis on April 2, at the age of fifty-nine years.

We regret also to record the death of M. Victor Raulin, emeritus professor of geology at Bordeaux, at the age of ninety years, and of M. Julien, professor of geology at Clermont-Ferrand, at the age of sixty-five years.

There will be a civil service examination on May 10 to fill at least three vacancies in the position of civil engineer student in the Division of Tests, Bureau of Chemistry, Department of Agriculture, at not exceeding $50 per month each.

A New York state civil service examination will be held on April 22 to fill the position of histological laboratory assistant in the Pathological Institute at a salary of $1,200. The position is open to both men and women.

A consular report states that the erection of the institute for cancer investigation, to be in the immediate vicinity of the Academy Hospital at Heidelberg, will be begun as soon as possible, and its completion is expected in the spring of 1906. It will be the first larger institution of its kind in Germany, and probably in Europe, where scientific investigation will be combined with treatment of patients. While the lower floor will serve exclusively for making bacteriological, pathological and other researches, and while the entire equipment will reflect the most modern scientific knowledge, the second floor will accommodate about forty patients who may expect temporary or permanent relief. The first impetus for this institute was given by an unknown party, who nine months ago donated the sum of 150,000 Marks for this purpose, on condition that it should be used exclusively for a hospital at Heidelberg devoted to cancer investigation. Other unknown donors have increased the fund to about $60,000. The government of the Grand Duchy of Baden, in accepting the trust on the part of the Grand Duke, has furnished the ground for the building and consented to manage the institution, for which purpose a considerable appropriation will be made.

UNIVERSITY AND EDUCATIONAL NEWS.

The authorities of Stevens Institute of Technology have taken up vigorously the task of raising the additional $100,000 required to render available the $100,000 conditionally donated by Mr. Andrew Carnegie and President Alexander C. Humphreys ($50,000 each) at the recent dinner of the Stevens alumni. It is expected that the alumni will heartily cooperate by contributing and by awakening the interest of their friends.

The chair of social and political ethics at Columbia University, held by Professor Felix Adler, has been endowed. The university has also received $10,000 from Mr. F. L. Stetson towards a building for the Law School.

Dr. Lewellys F. Barker, professor of anatomy at the University of Chicago, has been called to the chair of medicine in Johns Hopkins University, vacant by the removal of Dr. William Osler to Oxford. At the same time Dr. W. S. Thayer, associate professor of medicine, has been advanced to a professorship of clinical medicine.

Dr. B. B. Gallaudet, demonstrator in anatomy at Columbia University, has been appointed adjunct professor, and Dr. W. P. Montague, tutor in philosophy, has been made instructor.

Thomas C. Esty, professor of mathematics at Rochester University, has received a call to a similar position at Amherst, where he will succeed his father, Professor William C. Esty, who has been an instructor at Amherst for forty-three years.

Wm. A. Hilton, Ph.D., formerly assistant in histology and embryology in Cornell University, has been appointed to the chair of biology in Pomona College for the coming year.